

# DEPARTMENT OF COMPUTER SCIENCES AND ELECTRICAL ENGINEERING

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## Programs

- Computer and Information Security, B.S. (<http://catalog.marshall.edu/undergraduate/programs-az/engineering-computer-sciences/computer-sciences-electrical-engineering/computer-information-security-bs/>)
- Computer and Information Security, Minor (<http://catalog.marshall.edu/undergraduate/programs-az/engineering-computer-sciences/computer-sciences-electrical-engineering/computer-information-security-minor/>)
- Computer Science, Accelerated Master's degree (<http://catalog.marshall.edu/undergraduate/programs-az/engineering-computer-sciences/computer-sciences-electrical-engineering/computer-science-accelerated-masters/>)
- Computer Science, B.S. (<http://catalog.marshall.edu/undergraduate/programs-az/engineering-computer-sciences/computer-sciences-electrical-engineering/computer-science-bs/>)
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- Cybersecurity, Accelerated Master's Degree (<http://catalog.marshall.edu/undergraduate/programs-az/engineering-computer-sciences/computer-sciences-electrical-engineering/cybersecurity-accelerated-masters/>)
- Data Science, Accelerated Master's Degree (<http://catalog.marshall.edu/undergraduate/programs-az/engineering-computer-sciences/computer-sciences-electrical-engineering/data-science-accelerated-masters/>)
- Electrical and Computer Engineering, B.S.E.E. (<http://catalog.marshall.edu/undergraduate/programs-az/engineering-computer-sciences/computer-sciences-electrical-engineering/electrical-computer-engineering-bsee/>)
- Pre-Computer Science (<http://catalog.marshall.edu/undergraduate/programs-az/engineering-computer-sciences/computer-sciences-electrical-engineering/pre-computer-science/>)

## Courses

 - General Education Course

## Computer Science

**CS 101 Coding** **1 Credit hour**

This course is designed to expose students to coding with no previous programming experience. The topic covers basic programming with software development methodologies.

**Grade Mode:** Normal Grading Mode

**CS 105  Expl World with Computing (CT)** **3 Credit hours**

Central principles and big ideas of computing: problem-solving, computational and critical thinking, abstraction, creativity, reasoning, data, algorithms, recursion, visualization, and limits of computation. Solve real-world problems with computing.

**Pre-req:** ACT Math with a score of 17 or SAT Verbal Before March 16 with a score of 400 or SAT MATH SECTION SCORE with a score of 440 or Placement Math After SP17 with a score of 101 or MTH 102 with a minimum grade of C or MTH 102B with a minimum grade of C or MTH 127 with a minimum grade of C or MTH 130 with a minimum grade of C or MTH 132 with a minimum grade of C or MTH 229 with a minimum grade of C or MTH 229H with a minimum grade of C.

**Attributes:** Critical Thinking

**Grade Mode:** Normal Grading Mode

**CS 110 Computer Science I** **3 Credit hours**

**Pre-req:** ACT Math with a score of 24 or SAT Mathematics Before Mar. 16 with a score of 560 or SAT MATH SECTION SCORE with a score of 580 or MTH 127 or MTH 130 and MTH 132 (may be taken concurrently) or MTH 229 (may be taken concurrently) or MTH 229H (may be taken concurrently).

**Concurrent PR:** MTH 132 or MTH 229 or MTH 229H

**Grade Mode:** Normal Grading Mode

**CS 110H Computer Science Honors** **3 Credit hours**

Object-oriented and algorithmic problem solving principles and techniques; programming with classes in an integrated programming environment; and program debugging.

**Pre-req:** ACT Math with a score of 24 or SAT Mathematics Before Mar. 16 with a score of 560 or SAT MATH SECTION SCORE with a score of 580 or MTH 127 or MTH 130 and MTH 132 (may be taken concurrently) or MTH 129 (may be taken concurrently) or MTH 129H (may be taken concurrently).

**Concurrent PR:** MTH 132 or MTH 129 or MTH 129H

**Grade Mode:** Normal Grading Mode

**CS 120 Computer Science II** **3 Credit hours**

Object-oriented analysis and design, advanced programming with classes, arrays, strings, sorting, searching, I/O, GUI development, system life cycle and software development methodologies. CR/PR: CS 110

**Pre-req:** CS 110 or CS 110H.

**Grade Mode:** Normal Grading Mode

**CS 205 Scientific Computing** **3 Credit hours**

An introduction to computer programming, software design, and algorithm analysis and implementation. Abstract concepts illustrated with examples and exercises drawn from the mathematical and physical sciences. Primarily for non-CS majors.

**Pre-req:** MTH 140 or MTH 229 (may be taken concurrently) or MTH 229H (may be taken concurrently).

**Concurrent PR:** MTH 229 or MTH 229H

**Grade Mode:** Normal Grading Mode

<p><b>CS 210 Data Structures and Algorithms</b> <b>3 Credit hours</b>            Design and implementation of data structures including stacks, queues, lists, trees, heaps, balanced trees, and graphs. Other topics include hashing, threading, data parsing, program testing, correctness, efficiency, and exceptions. Data structures including stacks, queues, lists, trees, graphs, priority queues, and dictionaries.  <b>Pre-req:</b> CS 120 and MTH 220 (may be taken concurrently).  <b>Concurrent PR:</b> MTH 220  <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 320 Internetworking</b> <b>3 Credit hours</b>            Principles and issues in interconnecting multiple physical networks into a coordinated system, operation of internet protocols in the interconnected environment, and design of applications to operate in this environment.  <b>Pre-req:</b> CS 210 and (MTH 229 or MTH 229H).  <b>Grade Mode:</b> Normal Grading Mode</p>
<p><b>CS 215 Adv Data Struct and Algorithms</b> <b>3 Credit hours</b>            Advanced techniques for designing and analyzing algorithms, including asymptotic analysis; data structures; divide-and-conquer algorithms and recurrences; greedy algorithms; dynamic programming; graph algorithms; randomized algorithms; and NP-complete problems.  <b>Pre-req:</b> CS 210 and (MTH 229 or MTH 229H) and MTH 220 (may be taken concurrently).  <b>Concurrent PR:</b> MTH 220  <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 330 Operating Systems</b> <b>3 Credit hours</b>            Modern operating systems design and implementation: multi-tasking and time sharing, concurrency and synchronization, interprocess communication, resource scheduling, memory management, deadlocks, I/O, file systems, and security.  <b>Pre-req:</b> CS 210.  <b>Grade Mode:</b> Normal Grading Mode</p>
<p><b>CS 280 Special Topics</b> <b>1-4 Credit hours</b>            EMERGING TOPICS IN COMPUTER SCIENCE.  <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 351 Computer Sciences Co-Op</b> <b>0 Credit hours</b>            A supervised experience in which the student works for a company to gain practical experience in a students major.  <b>Pre-req:</b> ENGR 217 with a minimum grade of D.  <b>Grade Mode:</b> Credit/No Credit Grade Only</p>
<p><b>CS 281 Special Topics</b> <b>1-4 Credit hours</b>            EMERGING TOPICS IN COMPUTER SCIENCE.  <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 360 Automata and Formal Languages</b> <b>3 Credit hours</b>            Basic theoretical concepts are introduced, including finite state automata, regular expressions, context-free grammars, pushdown automata, Turing machines, recursively enumerable languages, the halting problem, and the Church-Turing thesis.  <b>Pre-req:</b> MTH 220 and CS 210.  <b>Grade Mode:</b> Normal Grading Mode</p>
<p><b>CS 282 Special Topics</b> <b>1-4 Credit hours</b>            EMERGING TOPICS IN COMPUTER SCIENCE.  <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 370 Computer Graphics</b> <b>3 Credit hours</b>            Mathematical theory and practical tools and techniques for generating realistic pictures using computers. This is a project-centered course and involves extensive programming using the open GL standard.  <b>Pre-req:</b> CS 210 with a minimum grade of D.  <b>Grade Mode:</b> Normal Grading Mode</p>
<p><b>CS 283 Special Topics</b> <b>1-4 Credit hours</b>            EMERGING TOPICS IN COMPUTER SCIENCE.  <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 402 Computer Architecture</b> <b>3 Credit hours</b>            Design and analyze structure of major hardware components of computers including: ALU, instruction sets, memory hierarchy, parallelism through multicore and many core, storage systems and interfaces.  <b>Pre-req:</b> CS 300.  <b>Grade Mode:</b> Normal Grading Mode</p>
<p><b>CS 300 Programming Languages</b> <b>3 Credit hours</b>  <b>Pre-req:</b> CS 210.  <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 404 High Performance Computing</b> <b>3 Credit hours</b>            Software design and development targeting high performance computing architectures. Multi-core and many-core systems: I/O, file systems, performance metrics. Programming models include MPI, OpenMP, MapReduce, CUDA, OpenCL.  <b>Pre-req:</b> CS 402.  <b>Grade Mode:</b> Normal Grading Mode</p>
<p><b>CS 305 Software Engineering</b> <b>3 Credit hours</b>            This course provides a broad introduction to software engineering theories, methods, and tools. Requires substantial writing. Topics include requirements engineering, analysis and design, implementation, versioning, and testing.  <b>Pre-req:</b> MTH 220 and CS 210 and ENG 354 (may be taken concurrently).  <b>Concurrent PR:</b> ENG 354  <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 405 Computing for Bioinformatics</b> <b>3 Credit hours</b>            Study of computational algorithms and programming techniques for various bioinformatics tasks including parsing DNA files, sequence alignments, tree construction, clustering, species identification, principal component analysis, correlations, and gene expression arrays.  <b>Pre-req:</b> CS 215.  <b>Grade Mode:</b> Normal Grading Mode</p>
<p><b>CS 310 Software Engineering II</b> <b>3 Credit hours</b>  <b>Pre-req:</b> CS 305.  <b>Grade Mode:</b> Normal Grading Mode</p>	
<p><b>CS 315 Software Quality Assurance</b> <b>3 Credit hours</b>            Testing techniques and validation of system requirements. Design reviews and code inspections; unit, integration, system, regression, load, stress, user acceptance, and regression testing; statistical testing; test strategies and project metrics.  <b>Pre-req:</b> CS 310 and MTH 345.  <b>Grade Mode:</b> Normal Grading Mode</p>	

<p><b>CS 410 Database Engineering</b> <b>3 Credit hours</b> Study of data models, data description languages, query languages including relational algebra and SQL, logical and physical database design, transactions, backup and recovery. Design and implementation of a database application. <b>Pre-req:</b> CS 210. <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 455 Systems Engineering</b> <b>3 Credit hours</b> Tools and techniques for optimizing the design and construction of software-intensive systems by considering system issues and making engineering tradeoffs in conflicting criteria and interacting decision parameters. <b>Pre-req:</b> CS 330 and CS 340 and CS 350. <b>Grade Mode:</b> Normal Grading Mode</p>
<p><b>CS 412 Embedded Systems</b> <b>3 Credit hours</b> The design of systems containing embedded computers. Micro-controller technology, assembly language and C programming, input/output interfacing, data acquisition hardware, interrupts, and timing. Real-time operating systems and application programming. Application examples. <b>Pre-req:</b> CS 402. <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 475 Internship</b> <b>3-12 Credit hours</b> An in-depth and hands-on involvement in a real-world project under direct professional supervision. The project may be on-campus or off-campus. Requires prior approval of the internship director, who is a member of the computer science faculty. <b>Pre-req:</b> CS 300 or CS 215. <b>Grade Mode:</b> Credit/No Credit Grade Only</p>
<p><b>CS 415 Data Mining</b> <b>3 Credit hours</b> Covers (1) the process of knowledge discovery, (2) algorithms (association rules, classification, and clustering), and (3) real-world applications. Focuses on efficient data mining algorithms and scaling up data mining methods. <b>Pre-req:</b> CS 215 and CS 410. <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 480 Special Topics</b> <b>1-4 Credit hours</b> EMERGING TOPICS IN COMPUTER SCIENCE. <b>Grade Mode:</b> Normal Grading Mode</p>
<p><b>CS 425 Computational Intelligence</b> <b>3 Credit hours</b> Genetic algorithms, evolutionary strategies, and genetic programming. Methods of knowledge representation using rough sets, type-1 fuzzy sets, and type-2 fuzzy sets. Neural network architectures and their learning algorithms. <b>Pre-req:</b> CS 300. <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 481 Special Topics</b> <b>1-4 Credit hours</b> EMERGING TOPICS IN COMPUTER SCIENCE. <b>Grade Mode:</b> Normal Grading Mode</p>
<p><b>CS 430 Cyber Security</b> <b>3 Credit hours</b> Concepts and issues in physical and cyber security; technological vulnerabilities found in operating systems, database servers, web servers, internet, and local area networks; developing defensive and offensive security measures. <b>Pre-req:</b> CS 320. <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 482 Special Topics</b> <b>1-4 Credit hours</b> EMERGING TOPICS IN COMPUTER SCIENCE. <b>Grade Mode:</b> Normal Grading Mode</p>
<p><b>CS 435 Cyber Risk</b> <b>3 Credit hours</b> Advanced course on the functions and purposes of the latest development in cyber security techniques and tools used to create, secure, protect and remediate cyber-infrastructures from various cyber threats. <b>Pre-req:</b> CS 430 or CS 340. <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 483 Special Topics</b> <b>1-4 Credit hours</b> EMERGING TOPICS IN COMPUTER SCIENCE. <b>Grade Mode:</b> Normal Grading Mode</p>
<p><b>CS 440 Digital Image Processing</b> <b>3 Credit hours</b> Mathematical techniques, algorithms, and software tools for image sampling, quantization, coding and compression, enhancement, reconstruction, and analysis. <b>Pre-req:</b> CS 210 and MTH 329. <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 485 Independent Study</b> <b>1-4 Credit hours</b> EMERGING TOPICS IN COMPUTER SCIENCE. <b>Grade Mode:</b> Normal Grading Mode</p>
<p><b>CS 452 Natural Language Processing</b> <b>3 Credit hours</b> Fundamental algorithms and computational models for core tasks in natural language processing: word and sentence tokenization, parsing, information and meaning extraction, spelling correction, text summarization, question answering, and sentiment analysis. <b>Pre-req:</b> (CS 215 and MTH 220). <b>Grade Mode:</b> Normal Grading Mode</p>	<p><b>CS 486 Independent Study</b> <b>1-4 Credit hours</b> EMERGING TOPICS IN COMPUTER SCIENCE. <b>Grade Mode:</b> Normal Grading Mode</p>
	<p><b>CS 487 Independent Study</b> <b>1-4 Credit hours</b> EMERGING TOPICS IN COMPUTER SCIENCE. <b>Grade Mode:</b> Normal Grading Mode</p>
	<p><b>CS 488 Independent Study</b> <b>1-4 Credit hours</b> EMERGING TOPICS IN COMPUTER SCIENCE <b>Grade Mode:</b> Normal Grading Mode</p>
	<p><b>CS 490 🌱 Senior Project</b> <b>3 Credit hours</b> Application of technical and professional skills in solving a real-world problem in a team environment. Discuss professional code of conduct, societal issues, and transition from student to industry professional. <b>Pre-req:</b> CS 310 and CS 410. <b>Attributes:</b> Capstone Course <b>Grade Mode:</b> Normal Grading Mode</p>
	<p><b>CS 491 Senior Project II</b> <b>3 Credit hours</b> Senior capstone experience. Application of technical and professional skills in constructing and testing a real-world problem in a team environment. <b>Pre-req:</b> CS 490. <b>Grade Mode:</b> Normal Grading Mode</p>

## Computer & Info Security

### **CYBR 210 Comp and Info Sec Principle** 3 Credit hours

Introduction to the various technical and administrative aspects of Computer and Information Security. Understanding key issues associated with protecting information assets, determining the protection needed and response to security incidents.

**Pre-req:** CS 105 or CS 110 or CS 110H.

**Grade Mode:** Normal Grading Mode

### **CYBR 240 Information Security Policies** 3 Credit hours

Introduction to information security policies, sociological and psychological issues in policy implementation in general. Discuss the lifecycle of policy creation, enactment in different domains of security and policy structure.

**Pre-req:** CS 105 or CS 110 or CS 110H.

**Grade Mode:** Normal Grading Mode

### **CYBR 310 Introduction to Cryptography** 3 Credit hours

This course covers the basic aspects of modern cryptography, including block ciphers, pseudorandom functions, symmetric encryption, Hash functions, message authentication, number theoretic primitives, public-key encryption, digital signatures and zero knowledge proofs.

**Pre-req:** CS 210 and (STA 225 or STA 345).

**Grade Mode:** Normal Grading Mode

### **CYBR 330 Cyber Security** 3 Credit hours

Concepts and issues in physical and cyber security; technical vulnerabilities found in operating systems, database servers, Web servers, Internet, and local area networks; developing defensive and offensive security measures.

**Grade Mode:** Normal Grading Mode

### **CYBR 350 Cyber System Administration** 3 Credit hours

Introduction of System Administration and related topics, including trouble-shooting system and network problems, hardware and software configuration and installation, basic scripting, and security aspects of Internet hosts.

**Pre-req:** CS 320 with a minimum grade of D.

**Grade Mode:** Normal Grading Mode

### **CYBR 360 Cyber Infrastructure Security** 3 Credit hours

Comprehensive analysis on the utilization and augmentation of cyber security technologies to harden cyber infrastructure and its interconnected cyber-physical systems against various attacks.

**Pre-req:** CS 320 with a minimum grade of D.

**Grade Mode:** Normal Grading Mode

### **CYBR 400 Computer Security Design** 3 Credit hours

Foundation technical and analytical skills to implement comprehensive computer security that encompass designing secure systems, information security, protecting information assets, managing computer security, risk mitigation strategies, and incident response.

**Pre-req:** CYBR 350.

**Grade Mode:** Normal Grading Mode

### **CYBR 435 Cyber Risk** 3 Credit hours

Advanced course on the functions and purposes of the latest development in cyber security techniques and tools used to create, secure, protect and remediate cyber-infrastructures from various cyber threats.

**Pre-req:** CYBR 330 or CS 330.

**Grade Mode:** Normal Grading Mode

### **CYBR 442 Cyber Operations** 3 Credit hours

Study of various concepts and aspects in choosing, deploying, supporting, troubleshooting and securing various local and distributed components of a cyber operation with consideration of the human factor.

**Pre-req:** CYBR 350 and CYBR 360.

**Grade Mode:** Normal Grading Mode

### **CYBR 475 Internship** 3 Credit hours

An in-depth and hands-on involvement in a real-world project under direct professional supervision. The project may be on-campus or off-campus.

**Grade Mode:** Normal Grading Mode

### **CYBR 480 Special Topics** 1-4 Credit hours

Study of an advanced topic not normally covered in other courses.

**Grade Mode:** Normal Grading Mode

### **CYBR 481 Special Topics** 1-4 Credit hours

Study of an advanced topic not normally covered in other courses.

**Grade Mode:** Normal Grading Mode

### **CYBR 482 Special Topics** 1-4 Credit hours

Study of an advanced topic not normally covered in other courses.

**Grade Mode:** Normal Grading Mode

### **CYBR 483 Special Topics** 1-4 Credit hours

Study of an advanced topic not normally covered in other courses.

**Grade Mode:** Normal Grading Mode

### **CYBR 484 Special Topics** 1-4 Credit hours

Study of an advanced topic not normally covered in other courses.

**Grade Mode:** Normal Grading Mode

### **CYBR 485 Special Topics** 1-4 Credit hours

Study of an advanced topic not normally covered in other courses.

**Grade Mode:** Normal Grading Mode

### **CYBR 486 Independent Study** 1-4 Credit hours

Independent study for selected juniors and seniors under supervision of faculty; may be repeated only once.

**Grade Mode:** Normal Grading Mode

### **CYBR 487 Independent Study** 1-4 Credit hours

Independent study for selected juniors and seniors under supervision of faculty; may be repeated only once.

**Grade Mode:** Normal Grading Mode

### **CYBR 488 Independent Study** 1-4 Credit hours

Independent study for selected juniors and seniors under supervision of faculty; may be repeated only once.

**Grade Mode:** Normal Grading Mode

### **CYBR 489 Independent Study** 1-4 Credit hours

Independent study for selected juniors and seniors under supervision of faculty; may be repeated only once.

**Grade Mode:** Normal Grading Mode

### **CYBR 490 🌱 Senior Project** 3 Credit hours

Application of technical and professional skills in solving a real-world problem in a team environment. Discuss professional code of conduct, societal issues, and transition from student to industry professional.

**Pre-req:** CYBR 330.

**Attributes:** Capstone Course

**Grade Mode:** Normal Grading Mode

## Electrical Engineering

### EE 202 Circuits II 3 Credit hours

The transient response of first and second order systems. Balanced three-phase systems. Mutual inductance, transformers, resonance, and two-port networks.

**Pre-req:** ENGR 201 with a minimum grade of D and MTH 230 with a minimum grade of D.

**Grade Mode:** Normal Grading Mode

### EE 204 Intro to Digital Systems 3 Credit hours

Number systems, digital components and systems, Boolean switching algebra; the analysis and design of combinational and sequential circuits; introduction to computer architecture.

**Pre-req:** MTH 220 with a minimum grade of D.

**Grade Mode:** Normal Grading Mode

### EE 210 Programming Lab 3 Credit hours

This course introduces students to the fundamental principles of programming for solving engineering programs. It familiarizes students with the process of translating real-life engineering problems to computation problems.

**Pre-req:** CS 110.

**Grade Mode:** Normal Grading Mode

### EE 211 Intro to Computer Engineering 3 Credit hours

Provide a study of Data Structure, operating systems' concepts, HW designed methods and relationship between hardware and software.

**Pre-req:** EE 210 with a minimum grade of D.

**Grade Mode:** Normal Grading Mode

### EE 310 Electromagnetic Fields 3 Credit hours

This course provides in depth coverage of all aspects electromagnetics, with a focus on field and wave generation and propagation. The course will focus on more practical aspects of E-M theory.

**Pre-req:** EE 202 with a minimum grade of D and MTH 335 with a minimum grade of D.

**Grade Mode:** Normal Grading Mode

### EE 320 Analysis of Signals & Systems 3 Credit hours

This class introduces students to concepts of probability and random variables necessary for study of signals and systems involving uncertainty; applications to elementary problems in detection, signal processing and communication.

**Pre-req:** MTH 335.

**Grade Mode:** Normal Grading Mode

### EE 330 Random Signals and Systems 3 Credit hours

This course will introduce the students to the fundamental concepts of probability theory applied to engineering problems, including elementary set operations, sample spaces and probability laws, conditional probability and independence.

**Pre-req:** MTH 231 with a minimum grade of D.

**Grade Mode:** Normal Grading Mode

### EE 340 Computer Architecture & Design 4 Credit hours

This course is a study of the factors influencing the design of hardware and software elements of computer systems. Topics include: instruction set design; cache and virtual memory organizations.

**Pre-req:** EE 211 with a minimum grade of D.

**Grade Mode:** Normal Grading Mode

### EE 350 Elect Properties of Materials 3 Credit hours

Introduction to basic physical properties of solid materials; some solid state physics employed, but major emphasis is on engineering applications based on semiconducting, magnetic, dielectric and superconducting phenomena.

**Pre-req:** EE 202 with a minimum grade of D.

**Grade Mode:** Normal Grading Mode

### EE 360 Control Systems 3 Credit hours

Application of state variable and frequency domain techniques to modeling, analysis and synthesis of single input, single output linear control systems.

**Pre-req:** EE 202.

**Grade Mode:** Normal Grading Mode

### EE 370 Electric Machinery 3 Credit hours

Fundamentals of energy-handling electric circuits, analysis of power electric circuits, elements of linear and rotating electric machinery, induction, and DC machinery.

**Pre-req:** EE 310 with a minimum grade of D.

**Grade Mode:** Normal Grading Mode

### EE 375 Communication Systems I 3 Credit hours

Introduction to the fundamental concepts of computer communication networks. Topics include the OSI reference model, the physical data link, network, and transport layers, TCP/IP, LANs, ALOHA, routing and flow controls.

**Pre-req:** EE 310 with a minimum grade of D and EE 320 (may be taken concurrently) with a minimum grade of D.

**Concurrent PR:** EE 320

**Grade Mode:** Normal Grading Mode

### EE 380 Microprocessor Design 3 Credit hours

Hardware and software for real-time microprocessor-based digital systems. Basic concepts of on-chip components related to digital system functionality. Introduction to 32-bit machines with treatment of 16- and 8-bit machines.

**Pre-req:** EE 204 with a minimum grade of D and EE 340 with a minimum grade of D.

**Grade Mode:** Normal Grading Mode

### EE 401 Communication Systems II 3 Credit hours

This course will cover topics in the field of RF/microwave engineering, such as transmission lines, waveguides, impedance matching, microwave resonators, RF filters, RF amplifiers and an introduction to antenna design.

**Pre-req:** EE 375 with a minimum grade of D.

**Grade Mode:** Normal Grading Mode

### EE 410 Electrical Engineering Design 3 Credit hours

Application of design process and project engineering as practiced in industry; team approach to the design process; development of a project proposal; proposed project implemented in EE 420.

**Grade Mode:** Normal Grading Mode

### EE 411 Intro to Digital IC Design 3 Credit hours

This course covers the analysis and design of digital integrated circuits using CMOS technology. The course emphasizes design of circuit layout, and HSPICE and IRSIM for simulations, lab included.

**Pre-req:** ENGR 204.

**Grade Mode:** Normal Grading Mode

<b>EE 412 Computer Engineering Design</b>	<b>3 Credit hours</b>	<b>EE 502 Instrumentation</b>	<b>3 Credit hours</b>
Introduction to the design process and project engineering as practiced in industry; student teams apply the design process by developing a project from proposal; proposed project implemented in EE 420.		<b>Grade Mode:</b> Normal Grading Mode	
<b>Grade Mode:</b> Normal Grading Mode		<b>EE 503 Power Systems</b>	<b>3 Credit hours</b>
<b>EE 415 Intro VHDL Design &amp; HW Systems</b>	<b>3 Credit hours</b>	<b>Grade Mode:</b> Normal Grading Mode	
This course provides fundamental of hardware design methodologies and modeling. It covers the essentials of HDL, embedded C and hardware-embedded systems using VHDL language, Lab included.		<b>EE 504 Principles and Practices-EE</b>	<b>2 Credit hours</b>
<b>Pre-req:</b> EE 380 with a minimum grade of D.		<b>Grade Mode:</b> Normal Grading Mode	
<b>Grade Mode:</b> Normal Grading Mode		<b>EE 510 Design Digital Systems</b>	<b>3 Credit hours</b>
<b>EE 419 Intr Digital Signal Processing</b>	<b>3 Credit hours</b>	This course provides fundamental understanding of Digital circuits. Students learn the essentials of digital circuit operation, design and simulate digital circuits using the techniques of practicing electrical and computer engineers.	
This course covers the transformation, manipulation of signals. It introduces the concepts of discrete-time, discrete frequency domains, representations and analyses of systems, and filter designs, lab is included.		<b>Grade Mode:</b> Normal Grading Mode	
<b>Pre-req:</b> EE 350.		<b>EE 511 Analog Computation</b>	<b>3 Credit hours</b>
<b>Grade Mode:</b> Normal Grading Mode		<b>Grade Mode:</b> Normal Grading Mode	
<b>EE 420 🏠 Capstone Design</b>	<b>3 Credit hours</b>	<b>EE 514 Linear Systems</b>	<b>3 Credit hours</b>
Application of the design process and project engineering as practiced in industry; team approach to the design process; completion of project based on proposal from EE 410 or EE 412.		<b>Grade Mode:</b> Normal Grading Mode	
<b>Pre-req:</b> EE 410 with a minimum grade of D or EE 412 with a minimum grade of D.		<b>EE 515 Digital Signal Processing</b>	<b>3 Credit hours</b>
<b>Attributes:</b> Capstone Course, No Textbook Required		<b>Grade Mode:</b> Normal Grading Mode	
<b>Grade Mode:</b> Normal Grading Mode		<b>EE 529 Linear Systems &amp; Control</b>	<b>3 Credit hours</b>
<b>EE 425 Electric Power Systems</b>	<b>3 Credit hours</b>	The course provides a rigorous introduction to the analysis and control of linear dynamical systems in the time domain. The course introduces the fundamentals of linear spaces and linear operator theory.	
The course emphasizes power engineering area that includes power generation, transmission, and distribution.		<b>Grade Mode:</b> Normal Grading Mode	
<b>Pre-req:</b> EE 202 with a minimum grade of D.		<b>EE 530 Cyber-Physical Systems</b>	<b>3 Credit hours</b>
<b>Grade Mode:</b> Normal Grading Mode		This course provides an introduction to modeling and analysis of cyber-physical systems. Several models of continuous-time systems and discrete-time systems are introduced.	
<b>EE 440 Digital Control Systems</b>	<b>3 Credit hours</b>	<b>Grade Mode:</b> Normal Grading Mode	
Feedback systems in which a digital computer is used to implement the control law; Z-transform and time domain methods serve as a basis for control systems design.		<b>EE 535 Power System Protection</b>	<b>3 Credit hours</b>
<b>Pre-req:</b> EE 360.		This course covers the power system faults and application of relays for power system protection. Symmetrical components as applied fault currents. Introduction to digital filtering, microprocessor, computer simulation for relays.	
<b>Grade Mode:</b> Normal Grading Mode		<b>Grade Mode:</b> Normal Grading Mode	
<b>EE 445 Radio Freq &amp; Microwave Engr</b>	<b>3 Credit hours</b>	<b>EE 585 Independent Study</b>	<b>1-4 Credit hours</b>
Fundamental Radio Frequency (RF) and microwave circuit analysis; return loss, insertion loss; transmission lines, lumped elements, impedance matching; theory, analysis and design of basic RF and microwave passive circuits.		<b>Grade Mode:</b> Normal Grading Mode	
<b>Pre-req:</b> EE 320.		<b>EE 586 Independent Study</b>	<b>1-4 Credit hours</b>
<b>Grade Mode:</b> Normal Grading Mode		<b>Grade Mode:</b> Normal Grading Mode	
<b>EE 447 Real-Time Digital Processing</b>	<b>3 Credit hours</b>	<b>EE 587 Independent Study</b>	<b>1-4 Credit hours</b>
This course provides an introduction to the principles of real-time digital signal processing and hands-on development of real-time signal processing algorithms.		<b>Grade Mode:</b> Normal Grading Mode	
<b>Pre-req:</b> EE 320.		<b>EE 588 Independent Study</b>	<b>1-4 Credit hours</b>
<b>Grade Mode:</b> Normal Grading Mode		<b>Grade Mode:</b> Normal Grading Mode	
<b>EE 448 Power Electronics</b>	<b>3 Credit hours</b>	<b>EE 601 Power Systems Analysis</b>	<b>3 Credit hours</b>
Principles of power electronics. Including understanding of power semiconductor devices, passive components, basic switching circuits, AC/DC, DC/DC, DC/AC converters and their applications.		<b>Grade Mode:</b> Normal Grading Mode	
<b>Pre-req:</b> ENGR 202 and EE 310.		<b>EE 602 Random Signals &amp; Noise</b>	<b>3 Credit hours</b>
<b>Grade Mode:</b> Normal Grading Mode		This course provides an introduction to the fundamentals of random variables, random signals, and simulation of random phenomena.	
		<b>Grade Mode:</b> Normal Grading Mode	
		<b>EE 603 Protective Relaying in Powr Sys</b>	<b>3 Credit hours</b>
		<b>Grade Mode:</b> Normal Grading Mode	
		<b>EE 604 Electrical Machinery</b>	<b>3 Credit hours</b>
		<b>Grade Mode:</b> Normal Grading Mode	
		<b>EE 605 Comptr Meth in Power Sys Only</b>	<b>3 Credit hours</b>
		<b>Grade Mode:</b> Normal Grading Mode	

<b>EE 606 Electrical Analysis</b>	<b>3 Credit hours</b>	<b>EE 638 Nonlinear Sys &amp; Control</b>	<b>3 Credit hours</b>
This course covers Laplace transform for boundary-value problem, applications to control theory, frequency response of ordinary differential equations, linear algebra techniques; eigenvalue analysis of linear systems and in multivariate optimization.		The course provides a rigorous introduction to the analysis and control of nonlinear dynamical systems in time domain.	
<b>Grade Mode:</b> Normal Grading Mode		<b>Grade Mode:</b> Normal Grading Mode	
<b>EE 607 Adv Electrical Engr</b>	<b>3 Credit hours</b>	<b>EE 639 Renew Energy &amp; Dist Generation</b>	<b>3 Credit hours</b>
This course covers complex functions, complex integration, vectors, matrices, functions of matrices, Cayley-Hamilton theorem, state-space modeling, optimization techniques, least squares technique, total least squares, and numerical techniques.		This course covers the fundamentals of energy and sustainability; power efficiency; hydro, wind, solar, fuel systems; Converters and controllers for integration of renewable energy sources; Smart grid, hybrid generation systems.	
<b>Grade Mode:</b> Normal Grading Mode		<b>Grade Mode:</b> Normal Grading Mode	
<b>EE 608 Research Methods</b>	<b>3 Credit hours</b>	<b>EE 642 Pattern Recognition 1</b>	<b>3 Credit hours</b>
Overview of research methods in engineering. Research theory, design, ethics, and practice. Research plan and proposal. Experimental, numerical, and analytical research. Reviewing literatures, collect and analyze data quantitatively and qualitatively.		<b>Grade Mode:</b> Normal Grading Mode	
<b>Grade Mode:</b> Normal Grading Mode		<b>EE 643 Pattern Recognition 2</b>	<b>3 Credit hours</b>
<b>EE 611 Digital Design</b>	<b>3 Credit hours</b>	<b>Grade Mode:</b> Normal Grading Mode	
This course covers the CMOS circuits. Design approaches with emphasis placed on structured full custom design, MOS device, critical interconnect and gate characteristics. CMOS logic design from transistor to fabrication.		<b>EE 650 Special Topics</b>	<b>1-4 Credit hours</b>
<b>Grade Mode:</b> Normal Grading Mode		Subject matter to be selected from topics of current interest.	
<b>EE 615 Real Time Systems</b>	<b>3 Credit hours</b>	<b>Grade Mode:</b> Normal Grading Mode	
This course covers the Designing real-time embedded systems from a hardware and software perspective. Communications and signal processing systems. Applications to seismic monitoring, process control, and biomedical systems.		<b>EE 651 Special Topics</b>	<b>1-4 Credit hours</b>
<b>Grade Mode:</b> Normal Grading Mode		Subject matter to be selected from topics of current interest.	
<b>EE 618 Data &amp; Comm Networks</b>	<b>3 Credit hours</b>	<b>Grade Mode:</b> Normal Grading Mode	
This course introduces the underlying concepts behind networking using the internet and its protocols as examples.		<b>EE 652 Special Topics</b>	<b>1-4 Credit hours</b>
<b>Grade Mode:</b> Normal Grading Mode		Subject matter to be selected from topics of current interest.	
<b>EE 624 Wireless Communication</b>	<b>3 Credit hours</b>	<b>Grade Mode:</b> Normal Grading Mode	
This course introduces fundamental technologies for wireless communication.		<b>EE 653 Special Topics</b>	<b>1-4 Credit hours</b>
<b>Grade Mode:</b> Normal Grading Mode		Subject matter to be selected from topics of current interest.	
<b>EE 630 Robust Control</b>	<b>3 Credit hours</b>	<b>Grade Mode:</b> Normal Grading Mode	
Linear systems, norms for signals and systems, stability and performance, uncertainty and robustness, parameterization of stabilizing controllers, algebraic Riccati equations, H <sub>2</sub> control, and H <sub>∞</sub> control.		<b>EE 656 Semiconductr Switchng Circuits</b>	<b>3 Credit hours</b>
<b>Grade Mode:</b> Normal Grading Mode		<b>Grade Mode:</b> Normal Grading Mode	
<b>EE 631 Optimal Control</b>	<b>3 Credit hours</b>	<b>EE 658 Linear Syst-State Space Appro</b>	<b>3 Credit hours</b>
The course introduces the theory of Optimal Control. It covers evaluation methods for control signals that satisfy some physical constraints and minimize or maximize some performance measures.		<b>Grade Mode:</b> Normal Grading Mode	
<b>Grade Mode:</b> Normal Grading Mode		<b>EE 661 Continuous &amp; Digital Cntrl Sys</b>	<b>3 Credit hours</b>
<b>EE 636 Power System Operation</b>	<b>3 Credit hours</b>	<b>Grade Mode:</b> Normal Grading Mode	
This course covers modern power systems, operational, control problems, solution techniques. State estimation, contingency analysis, load-frequency control and automatic generation control, load flow analysis and external equivalents for steady-state operations.		<b>EE 681 Microprocessors-Prin &amp; Appl 1</b>	<b>3 Credit hours</b>
<b>Grade Mode:</b> Normal Grading Mode		<b>Grade Mode:</b> Normal Grading Mode	
		<b>EE 682 Microprocessors-Prin &amp; Appl 2</b>	<b>3 Credit hours</b>
		<b>Grade Mode:</b> Normal Grading Mode	
		<b>EE 683 Microcomputer-Based Design</b>	<b>3 Credit hours</b>
		Surface and subsurface geology, geotechnical properties of soil and rock. Geotechnical engineering design aspects of landfills, groundwater barriers, tunneling. Mechanics of ground movements, sediment and erosion control. (PR: Engine- ering or Geology degree)	
		<b>Grade Mode:</b> Normal Grading Mode	
		<b>EE 684 Unknown</b>	<b>3 Credit hours</b>
		<b>EE 685 Independent Study</b>	<b>1-4 Credit hours</b>
		Independent study in which a student meets regularly with a faculty member to discuss assignments.	
		<b>Grade Mode:</b> Normal Grading Mode	
		<b>EE 686 Independent Study</b>	<b>1-4 Credit hours</b>
		Independent study in which a student meets regularly with a faculty member to discuss assignments.	
		<b>Grade Mode:</b> Normal Grading Mode	
		<b>EE 687 Independent Study</b>	<b>1-4 Credit hours</b>
		Independent study in which a student meets regularly with a faculty member to discuss assignments.	
		<b>Grade Mode:</b> Normal Grading Mode	

**EE 688 Independent Study 1-4 Credit hours**

Independent study in which a student meets regularly with a faculty member to discuss assignments.

**Grade Mode:** Normal Grading Mode

**EE 690 Special Topics 1-6 Credit hours**

**Grade Mode:** Normal Grading Mode

**EE 698 Design Project 3 Credit hours**

The course introduces the principles of product design: specifications, evaluation of design alternatives, technical reports and oral presentations. Intellectual property, industry standards and conventions, engineering economics, reliability, safety, engineering ethics.

**Grade Mode:** Normal Grading Mode

**EE 699 Thesis 1-6 Credit hours**

This represents the course designation for a Master's Degree Research Thesis. Successful completion of a thesis fulfills the research requirement for the M.S. degree in Electrical Engineering.

**Attributes:** Thesis

**Grade Mode:** Normal Grading Mode

**EE 790 Advanced Independent Study 3 Credit hours**