BME 5572 ECS-ECE 3(3,0)
Biomedical Nanotechnology: PR: EEE 3350 or C.I. Human Physiology, Bioelectric Phenomena and Neurons, Nanoelectronics for fabrication of biochips for human biomedical applications, self-assembly, bioelectronics, moral and ethical issues. Occasional.

CAP 4053 ECS-CS 3(3,0)
AI for Game Programming: PR: CS Foundation Exam or EEL 4851C or C.I. Surveys cutting-edge AI techniques for video games and board games and contrasts them with more traditional approaches. Spring.

CAP 4104 ECS-CS 3(3,0)
Human and Technology Interaction: PR: COP 3330 and COP 3502C. Perceptual, cognitive, affective, social, organizational, commercial, and cultural factors. Disciplines, techniques and methodologies. Web, mobiles, and wearables. Embodied conversational agents. Elderly, disabled and special needs. Fall.

CAP 4453 ECS-CS 3(3,0)
Robot Vision: PR: COP 3503C and MAC 2312, or C.I. Perspective and orthographic projections; the processing of edges, regions, motion, shading, texture, object detection, recognition, and machine learning. Fall, Spring.

CAP 4630 ECS-CS 3(3,0)

CAP 4720 ECS-CS 3(3,0)
Computer Graphics: PR: COP 3503C and COT 3960 and MAC 2147 or equivalent. Math for computer graphics, visibility and shading, graphics and data structure, curves and surfaces, commodity graphics hardware, and graphics API. Occasional.

CAP 5015 ECS-CS 3(3,0)
Multimedia Compression on the Internet: PR: Seniors and graduate students with interest in internet technology. Multimedia data; internet technology; entropy; compression methods; lossy compression; vector quantization; transform coding; wavelet video compression; model based compression. Occasional.

CAP 5055 ECS-CS 3(3,0)
AI for Game Programming: PR: CS Foundation Exam or EEL 4851C or C.I. Surveys cutting-edge AI techniques for video games and board games and contrasts them with more traditional approaches. Spring.
CAP 5066 ECS-CS 3(3,0)
Web Application Authoring Tools:
PR: Graduate standing and/or approval of the Director of the Software Engineering Certificate Program. A survey of available tools for creating and maintaining Web sites, and methodologies for; determining which tool is best suited for a particular application environment. Fall.

CAP 5100 ECS-CS 3(3,0)
Human-Computer Interface Design:
PR: COP 4331C, graduate standing and/or approval of the Director of the Software Engineering Certificate Program. Focuses on dynamics of human-computer interaction. Provides a comprehensive overview of HCI design as a software discipline. Features a user-centered approach to Web-based application design. Fall.

CAP 5415 ECS-CS 3(3,0)
Computer Vision:
PR: COP 3503C, MAC 2312 and COT 3960. Image formation, binary vision, region growing and edge detection, shape representation, dynamic scene analysis, texture, stereo and range images, and knowledge representation. Fall.

CAP 5510 ECS-CS 3(3,0)
Bioinformatics:
PR: Background in programming language or molecular biology. This course introduces problems, concepts, algorithms, and applications in Bioinformatics. It covers essential topics such as sequence alignment and prediction of gene and protein structure. Occasional.

CAP 5512 ECS-CS 3(3,0)
Evolutionary Computation:
PR: CAP 4630 or C.I.
This course covers the field of evolutionary computation, focusing on the theory and application of genetic algorithms. Spring.

CAP 5610 ECS-CS 3(3,0)
Machine Learning:

CAP 5636 ECS-CS 3(3,0)
Advanced Artificial Intelligence:
PR: CAP 4630.
AI theory of knowledge representation, “expert systems”, memory organization, problem solving, learning, planning, vision, and natural language. Fall.

CAP 5725 ECS-CS 3(3,0)
Computer Graphics I:
Architecture of graphics processors; display hardware; principles of programming and display software; problems and applications of graphic

CAP 6105. Pen-Based User Interfaces 3(3,0). PR: CAP 5610 or C.I. Designed to give students a thorough understanding of the techniques, algorithms, and evaluation methodologies used in designing and developing pen-, sketch-, and gesture-based user interfaces. Fall.

CAP 6121. 3D User Interfaces for Games and Virtual Reality 3(3,0). PR: CAP 5725 or C.I. Introduction to the design, implementation, and evaluation of the fundamental techniques in spatial 3D interaction. Spring.

CAP 6133. Advanced Topics in Computer Security and Computer Forensics 3(3,0). PR: COP 5611, COT 5405, CNT 5008. Advanced topics in computer security and forensics such as cryptography; automatic intrusion detection, advanced pattern matching, statistical techniques, firewalls, and vulnerability scanning. Occasional.

CAP 6135. Malware and Software Vulnerability Analysis 3(3,0). PR: CNT 4704 or equivalent and CGS 5131, or C.I. Analyzes computer malicious codes, such as virus, worm, trojan, spyware, and software vulnerabilities, such as buffer-overflow. Even Fall.


CAP 6616. Neuroevolution and Generative and Developmental Systems
3(3,0). PR: COP 3503C or C.I. Focuses on evolving neural networks for difficult sequential decision and control tasks and associated issues in efficient encoding and representation. Occasional.

CAP 6640. Computer Understanding of Natural Language
3(3,0). PR: CAP 5636. A study of the different approaches to build programs to understand natural language. The theory of parsing, knowledge representation, memory, and inference will be studied. Spring.

CAP 6671. Intelligent Systems: Robots, Agents, and Humans
3(3,0). PR: CAP 5610 or C.I. Includes practical techniques for designing intelligent agents capable of planning, learning, and cooperation. Discussion of psychological/social issues. Spring.

CAP 6675. Complex Adaptive Systems
3(3,0). PR: Graduate standing or C.I. This course is an introduction to the field of complex adaptive systems and will cover basic definitions, theoretical background, and empirical analyses. Fall.

CAP 6676. Knowledge Representation
3(3,0). PR: CAP 5636. Topics covered include terminological languages, logicist approaches, ontologies, ontological and conceptual relativity, processes, intangibles, time, building large knowledge bases, and complexity analysis. Occasional.

CAP 6701. Real-time Realistic Rendering
3(3,0). PR: CAP 4720 or CAP 5725. GPU Programming; State-of-the-art algorithms for: Real-time rendering of lighting effects and realistic materials; Real-time volume rendering; real-time simulation and rendering of smoke. Occasional.

CAP 6721. Ray Tracing

CAP 6835. Visual Simulation, Rendering, and Photometry
CDA 3103 ECS-CS 3(3,0)

CDA 4150H ECS-CS 4(3,1)
Honors Computer Architecture: PR: Consent of Honors and COP 3402 and CDA 3103C. Basic processor design, hardwired and microprogrammed control, ALU, memory organization, pipelining, I/O and computer arithmetic. With Honors level content. Occasional.

CDA 5106 ECS-CS 3(3,0)
Advanced Computer Architecture: PR: EEL 4768C. Modern processor design, instruction-level parallelism, thread-level parallelism, data-level parallelism, memory hierarchy, and I/O. Fall, Spring.

CDA 5110 ECS-CS 3(3,0)
Parallel Architecture and Algorithms: PR: COT 4210, CDA 5106. General-purpose vs. special-purpose parallel computers; arrays, message-passing; shared-memory; taxonomy; parallelization techniques; communication synchronization and granularity; parallel data structures; automatic program restructuring. Occasional.

CDA 5215 ECS-CS 3(3,0)
Architecture and Design of VLSI: PR: EEL 4768C. Overview of VLSI technology. Logical design of basic subsystems; integrated system design tools; design of a VLSI computer system. Occasional.

CDA 5532 ECS-CS 3(3,0)


CEN 4020 ECS-CS 3(3,0)
Component-based Engineering Software: PR: EEL 4851C, EEL 4882. In-depth treatment of component-based software development including analysis design and implementation of correct and reusable software in different component levels. Occasional.

CEN 5016 ECS-CS 3(3,0)
Software Engineering: PR: COP 4331C. Application of formal software processes, engineering methods, and documentation standards to the development of large scale software systems. A team project is required. Spring.

CEN 5077 ECS-CS 3(3,0)  

CEN 5326 ECS-CS 3(3,0)  
Web Server Configuration and Maintenance: PR: COP 3502C, CNT 3004, graduate standing and/or approval of the Director of the Software Engineering Certificate Program. Offers a comprehensive overview of the tools and techniques needed to succeed as a Web Server Administrator, including the tasks they are expected to perform. Occasional.


ECS-Computer Science

CEN 6075. Formal Specification of Software Systems 3(3,0). PR: Discrete math (equivalent to COT 3100C, MAD 2104, or MHF 3302) or C.I. Issues and current research in formal specification and verification of software-intensive systems. mathematical models and formalisms. Odd Spring.

ECS-Electrical & Computer Eng

CEN 6081. Engineering Software Design in Distributed and Parallel Systems 3(3,0). PR: EEL 4882 and EEL 4884C or EEL 5881. This course will focus on engineering software design, implementation, configuration and performance evaluation of distributed and parallel systems. Occasional.

ECS-Computer Science

CGS 1060C ECS-CS 3(2,2)  
Introduction to Computer Science: History, typical computer, number systems, control and data flow, peripheral components, memory devices, effects of computers on society, applications of computers. Not open to Computer Science Majors. Fall, Spring. M&S fee: $15.00

CGS 1060H ECS-CS 3(2,2)  
Honors Introduction to Computer Science: PR: Permission of Honors. History, number systems, control and data flow, peripheral components, memory devices,
effects of computers on society, applications of computers. Not open to Computer Science Majors. Occasional. M&S fee: $15.00
CGS 2100C ECS-CS 3(2,1) Computer Fundamentals for Business: Uses of computers and software in business, including business applications, commercial packages, and the internet. Not open to Computer Science majors. Fall, Spring. M&S fee: $15.00
CGS 3175 ECS-CS 3(3,0) Internet Applications: PR: CGS 1060C. HTML coding, using images, sound and animation, advanced text formatting, forms and CGS scripts, introduction to javascript. Fall, Spring.
CIS 3360 ECS-CS 3(3,0) Security in Computing: PR: COP 3223 or EGN 3211

CIS 3362 ECS-CS 3(3,0)

CIS 4004 ECS-CS 3(3,0)

CIS 4313 ECS-CS 3(3,0)

CIS 4361 ECS-CS 3(3,0)
Secure Operating Systems and Administration: PR: COP 4600 or CGS 3763. Understanding of secure operating systems requirements, design principles and theories, protection methods, access control, authentication, vulnerability, analysis and case studies. Occasional.

CIS 4615 ECS-CS 3(3,0)
Secure Software Development and Assurance: PR: (COP 4600 or CGS 3763) and (CIS 3360 or CIS 3362) or C.I. Thread modeling. Secure code life-cycle, Buffer overflows, race conditions and format string problems, Inputs and clients, File system, Cryptography applications, UMLsec, Java security and Reverse engineering. Occasional.

CIS 5105 ECS-CS 3(3,0)

CIS 5378 ECS-CS 3(3,0)
Designing Secure Transactions in Web Applications: PR: Graduate standing and/or approval of the Director of the Software Engineering Certificate Program. Secure electronic commerce, data indirection, shell command injection, cross-site scripting, Web Trojans, symmetric encryption, security protocols, application vulnerabilities,
threats and hackers. Spring.

CIS 6386. Operation Systems and File System Forensics
3(3,0). PR: CGS 5131 or C.I. In-depth coverage of computer forensics related issues associated with multiple operating systems, multiple file systems, and applications.
Spring.
ECS-Engineering Technology
CIS 6395. Incident Response Technologies
3(3,0). PR: CGS 5131 or C.I. This course covers security incidents and intrusions. Topics include: identifying and categorizing incidents, responding to incidents, log analysis, network traffic analysis, and tools.
Spring.
ECS-Engineering Technology
CIS 6611. Software Engineering II
3(3,0). Occasional.
ECS-Computer Science

CNT 3004 ECS-CS 3(3,0)

CNT 4403 ECS-CS 3(3,0)
Network Security and Privacy: PR: (CNT 3004 or EEL 4781 or CNT 4704) and (CIS 3360 or CIS 3362) or C.I. Fundamentals of network security, protocols, secure applications, network intrusion detection, security policy, firewalls, and privacy issues. Occasional.

CNT 4603 ECS-CS 3(3,0)

System Administration and Maintenance: PR: CGS 3763. An examination of operating systems and applications installation, configuration, and maintenance, including client-server services, content management and deployment, server administration and management, and user/group management. Fall, Spring.

CNT 4703C ECS-CS 3(1,2)
Design and Implementation of Computer Communication Networks: PR: CNT 3004, COP 3502C, MAD 2104 or COT 3100C. Data communication networking technologies (TCP/IP, Ethernet, Gigabit Ethernet, ATM, Frame Relay), products (routers, switches, adapters, cabling). Base design and detailed configuration including hands-on exercises. Fall, Spring. M&S fee: $16.00

CNT 4704 ECS-CS 3(3,0)
Network design using layering. Introduces cabling, topology, architecture, hardware and software. Includes performance and control issues such as congestion control, error control, contention resolution. Occasional.

CNT 4714 ECS-CS 3(3,0)
Enterprise Computing: PR: CGS 3269, MAD 2104, COP 3330 and COP 3502C. Client-server architecture.
Server-side scripting: Servlets, JSP, PHP, JDBC and MySQL database; connectivity. Multi-threaded Java applications.
J2EE development. SSL., Event-driven programming.

Fall, Spring.

CNT 5008 ECS-CS 3(3,0)
Computer Communication Networks
Architecture: PR: EEL 4768C.
Computer networks, layers, protocols and interfaces, local area networks networking.

Fall.

CNT 6418. Computer Forensics II
3(3,0). PR: CGS 5131 or C.I. Computer network protocols and security models, cryptography, network intrusion detection and prevention, digital evidence collection and legal issues involved in network forensics, wireless security and forensics.

Spring.

ECS-Computer Science

CNT 6519. Wireless Security and Forensics
3(3,0). PR: CGS 5131 or C.I. Advanced topics in wireless network security, security management, cryptography, wireless forensics and related areas.

Odd Spring.

ECS-Computer Science

CNT 6707. Advanced Computer Networks
3(3,0). PR: CNT 5008 or C.I. Recent advances in computer networks, overlay and multihomed networks, routing and multicasting, Internet friendly protocols, congestion control, QoS-differentiated services, cellular networks.

Spring.

ECS-Computer Science

COP 2500C ECS-CS 4(3,1)
Concepts in Computer Science:
Fundamental concepts in program design, data structures, algorithms, analysis and a survey of topics in CS. Not open to Computer Science majors. Fall, Spring.

COP 3223 ECS-CS 3(3,0)
Introduction to Programming with C:
Equivalent to EGN 3211. Programming in C including arrays, pointer manipulation and use of standard C math and IO libraries.

Fall, Spring.

COP 3223H ECS-CS 3(3,0)
Honors Introduction to Programming with C:
PR: Consent of Honors. Programming with C including arrays, pointer manipulation and use of standard C math and IO libraries. With Honors content.

Fall.

COP 3330 ECS-CS 3(3,0)
Object Oriented Programming: PR: COP 3223.
Object oriented programming concepts (classes, objects, methods, encapsulating, inheritance, interfaces) and the expression of these concepts in the programming languages such as JAVA.

Fall, Spring.

COP 3402 ECS-CS 3(3,0)
Systems Software: PR: COP 3502C.
Design and development of assemblers, linkers, loaders, and compilers. Study memory hierarchy, program performance, and system level I/O.

Fall, Spring.

COP 3502C ECS-CS 3(3,0)
Computer Science I: PR: COP 3223 and MAC 1105.
Problem solving techniques, order analysis and notation, abstract data types, and recursion.

Fall, Spring.

COP 3502H ECS-CS 3(3,0)
Honors Computer Science I: PR:
Permission of
Honors and COP 3223 and MAC 1105.
Problem solving
techniques, order analysis and notation, 
abstract data types, 
and recursion. Occasional.
COP 3503C ECS-CS 4(3,1)

Computer Science II: PR: COP 3502C 
and COT 
3100C and (MAD 2104 and COP 3330). 
Algorithm design 
and analysis for tree, list, set, and graph 
data models; 
algorithmic strategies and applications, 
and algorithmic 
complexity analysis; sorting and 
searching; practical applications. 
Fall, Spring.
COP 3503H ECS-CS 4(3,1)

Honors Computer Science II: PR:
Permission of
Honors and (COP 3502H or COP 
3502C) and COP 3330 
and (MAD 2104 or COT 3100C). 
Algorithm design and 
analysis for tree, list, set, and graph data models; 
algorithmic strategies and applications, and 
algorithmic complexity 
analysis; sorting and searching; practical applications. With 
honors content. Fall.
COP 4020 ECS-CS 3(3,0)

Programming Languages I: PR: COP 3503C 
and COT 3960. Paradigms and 
fundamental concepts of 
programming languages are presented, 
including: scope, 
bounding, abstraction, encapsulation, 
typing etc. Design paradigms 
object-oriented, functional and logic 
programming are 
presented. Fall, Spring.
COP 4331C ECS-CS 4(3,1)

Processes for Object-Oriented 
Software 
Development: PR: COP 3502C, COP 
3330, COT 
3960 (Foundation Exam - for Computer Science students). 
Concepts, principles, processes and 
methods for developing 
large software systems featuring a team 
project using 
object-oriented design in UML and 
implementation in C++.
Occasional.
COP 4516C ECS-CS 3(1,3)

Problem Solving Techniques and 
Team 
Dynamics: PR: COP 3503C. Design and 
implement 
solutions to problems requiring the 
applications of the different algorithms. Team project format.
Occasional.
COP 4520 ECS-CS 3(3,0)

Concepts of Parallel and Distributed 
Processing: PR: COP 3402 and COP 
3503C and COT 
3960. Parallel and distributed paradigms, architectures 
and algorithms, and the analytical tools, environments and 
languages needed to support these 
paradigms. Occasional.
COP 4600 ECS-CS 3(3,0)

Operating Systems: PR: COP 3402 and COP 
3503C 
and COT 3960 for Computer Science 
students. Function 
and organization of operating systems, 
process management, 
virtual memory, I/O management, and 
file management. 
Fall, Spring.
COP 4610L ECS-CS 3(0,3)

Operating Systems Laboratory: PR: COP 3502C.
Exercises in the configuration, development, management and analysis of operating systems; OS Kernel support for semaphores and multi-tasking; security in a distributed heterogeneous environment. *Fall, Spring.*

**COP 4710 ECS-CS 3(3,0)**
**Database Systems:** PR: COP 3503C. Storage and access Structures, database models and languages, related database design, and implementation techniques for database management systems. *Fall, Spring.*

**COP 4910 ECS-CS 3(3,0)**
**Frontiers in Information Technology:** PR: COP 4610L or CNT 4703C. Research into leading edge information technologies that have a high likelihood of affecting the workplace in the two to five year time frame. *Spring.*

**COP 5021 ECS-CS 3(3,0)**
**Program Analysis:** PR: COP 4020 and COT 4210 or C.I. Static analysis of programs including theoretical and practical limitations, data flow analysis, abstract interpretation, and type and effect systems. Tools to automate program analysis. *Even Spring.*

**COP 5537 ECS-CS 3(3,0)**
**Network Optimization:** PR: Graduate standing or C.I. Techniques for modeling complex, interconnected systems as networks; optimization with graph theory; algorithms, data structures, and computational complexity; statistical methods for studying large, evolving networks. *Fall.*

**COP 5611 ECS-CS 3(3,0)**
**Operating Systems Design Principles:** PR: COP 4600. Structure and functions of operating systems, process communication techniques, high-level concurrent programming, virtual memory systems, elementary queuing theory, security, distributed systems, case studies. *Spring.*

**COP 5711 ECS-CS 3(3,0)**
**Parallel and Distributed Database Systems:** PR: COP 4710. Storage manager, implementation techniques for parallel DBMSs, distributed DBMS architectures, distributed database design, query processing, multidatabase systems. *Occasional.*

**COP 6525. Distributed Processing of Digital Evidence 3(3,0).** PR: CGS 5131 and COP 5611, or C.I. Parallel and distributed processing techniques using MPI in a cluster environment; data mining techniques used in analyzing large quantities of digital data. *Even Spring.*

**ECS-Computer Science**

**COP 6614. Operating Systems Techniques 3(3,0).** PR: COP 5611. Techniques in the design and implementation of operating systems. Case studies of several experimental and commercial operating systems. *Occasional.*

**ECS-Computer Science**

**COP 6621. Compiler Construction 3(3,0).** PR: COP 5021, COT 5310. Techniques in the design and implementation of compilers. Optimization, code generation, error
recovery, attributed grammars. A project is required. Occasional.

ECS-Computer Science

COP 6717. Database Interface Development
3(3,0). PR: COP 4710, CAP 5066, graduate standing and/or approval of the Director of the Software Engineering Certificate Program. Design and implementation techniques for incorporating database interfaces in Web applications. Comparison of tools and methodologies, including Microsoft .NET, Java JDBC, and PHP. Hands-on exercises. Spring.

ECS-Computer Science

COP 6730. Transaction Processing

ECS-Computer Science

COP 6731. Advanced Database Systems
3(3,0). PR: COP 5711. Selected topics concerning object-oriented databases, multimedia databases, active databases, temporal databases, spatial databases, and information systems. Occasional.

ECS-Computer Science

COT 3100C ECS-CS 3(3,1)

Introduction to Discrete Structures:
PR: MAC 1105, MAC 1114. Logic, sets, functions, relations, combinatorics, graphics, Boolean algebras, finite-state machines, Turing machines, insolvability, computational complexity.

Fall, Spring.

COT 3100H ECS-CS 3(3,0)

Honors Introduction to Discrete Structures:
PR: Permission of Honors and MAC 1105, MAC 1114.

Logic, sets, functions, relations, combinatorics, graphics, Boolean algebras, finite-state machines, Turing machines, insolvability, computational complexity. Occasional.

COT 3960 ECS-CS 0(1,0)


COT 4210 ECS-CS 3(3,0)


COT 4400 ECS-CS 3(3,0)


COT 4500 ECS-CS 3(3,0)

Numerical Calculus: PR: MAC 2312 and COP 3502C. Numerical methods for finding roots of nonlinear equations, solutions of systems of linear equations, and
ordinary differential equations.

*Occasional.*

**COT 4810 ECS-CS 3(3,0)**

**Topics in Computer Science:** PR: COP 3402 and COP 3503C and COT 3960. A range of topics from the field of Computer science; application of oral and written communication skills; social, ethical and moral issues of computing. *Fall, Spring.*

**COT 5310 ECS-CS 3(3,0)**

**Formal Languages and Automata Theory:** PR: COP 4020 and COT 4210. Classes of formal grammars and their relation to automata, normal forms, closure properties, decision problems. LR(K) grammars. *Fall, Spring.*

**COT 5405 ECS-CS 3(3,0)**

**Design and Analysis of Algorithms:** PR: COT 4210. Classification of algorithms, e.g., recursive, divide-and-conquer, greedy, etc. Data Structures and algorithm design and performance. Time and space complexity analysis. *Fall, Spring.*

**COT 5520 ECS-CS 3(3,0)**

**Computational Geometry:** CR: COT 5405.

Geometric searching, point location, convex hulls, proximity problems, Voronoi diagrams, spanning trees, triangulation, intersection arrangement applications. *Occasional.*

**COT 6300. The Theory of Parsing and Translation**

3(3,0). PR: COT 5310. Methods of top-down and bottom-up parsing, LL(k), recursive descent, precedence, bounded-context, SR(s,k), SLR(k), LALR(k), LR(k), parser compression and generation.

*Occasional.*

ECS-Computer Science

**COT 6410. Computational Complexity**

3(3,0). PR: COT 5405. Properties of algorithms, computational equivalence of machines, time-space complexity measures, examples of algorithms of different complexity, classification of algorithms, classes P and NP. *Occasional.*

ECS-Computer Science

**COT 6415. Complexity of Parallel Computation**


ECS-Computer Science

**COT 6417. Algorithms on Strings and Sequences**

3(3,0). PR: COT 5405 or C.I. Study of algorithms for exact and approximate string pattern matching, sequence alignment and multiple string alignment. *Occasional.*

ECS-Computer Science

**COT 6505. Computational Methods/Analysis I**


ECS-Computer Science

**COT 6600. Quantum Computing**

3(3,0). PR: COT 5405. This course
introduces basic concepts in quantum circuits and quantum algorithms. Occasional.
ECS-Electrical & Computer Eng

COT 6602. Introduction to Quantum Information Theory
ECS-Computer Science

ECM 5135. Engineering Math Analysis I
3(3,0). PR: MAP 2302. Topics in advanced engineering mathematics, including systems of differential equations, phase plane, linear algebra, and vector differential calculus. Occasional.
ECS-Electrical & Computer Eng

ECM 5741C. Microcomputer-based Monitoring and Control Systems
3(2,3). PR: EEE 3342C; EEL 4742C or C.I. Machine language programming; software development aids; systems design; interfacing considerations. Occasional.
ECS-Electrical & Computer Eng

ECM 6235. Engineering Math Analysis II
ECS-Electrical & Computer Eng

ECM 6308. Current Topics in Parallel Processing
3(3,0). PR: C.I. Research topics in parallel architectures, including, but not limited to, systolic architectures, wavefront arrays, interconnection networks, reconfigurable architectures and fast algorithms. May be used in the degree program a maximum of 2 times. Even Fall.
ECS-Electrical & Computer Eng

ECM 6805C. Microcomputer Applications Design
3(2,3). PR: C.I. Advanced applications of microcomputer systems. Design of systems and software to implement a case study in microcomputer usage. Occasional.
ECS-Electrical & Computer Eng

EEE 3307C ECS-ECE 4(3,3)
Electronics I: PR: EEL 3123C. Electronic devices including p-n junctions, bipolar transistors, field effect transistors and device models. Fall, Spring. M&S fee: $15.00

EEE 3342C ECS-ECE 3(2,3)
Digital Systems: PR: MAC 2311, MAC 2312, PHY 2048, PHY 2049 all with a “C” (2.0) or better grade. Combinational and sequential logic circuits including registers, arithmetic units, memories, finite state machines, and design with programmable logic devices. Fall, Spring. M&S fee: $15.00

EEE 3350 ECS-ECE 3(3,0)
Semiconductor Devices I: PR: EEL 3004. Electronic devices including p-n junctions, bipolar transistors, field effect transistors and device models. Fall, Spring.

EEE 4309C ECS-ECE 4(3,3)
Electronics II: PR: EEE 3307C, EEE 3342C. Ideal Op-Amps and applications. Introduction to Logic Circuits; Bipolar, MOS and CMOS families; Flip-flops and memory
cells, comparators and timing circuits: A/D and D/A converters.

Fall, Spring. M&S fee: $15.00

EEE 4314 ECS-ECE 3(3,0)
Device Electronics for Integrated Circuits:

EEE 4463 ECS-ECE 3(3,0)
MEMS Devices and Applications: PR: EEE 3350 or C.I. Micro-Electro Mechanical Systems devices, microfabrication, sensors and actuators, bulk and surface micromachining, optical MEMS, instrumentation and applications. Fall.

EEE 5332C ECS-ECE 3(2,1)
Thin Film Technology: PR: EEE 3350 or equivalent.

Presents the various thin film deposition techniques for the fabrication of microelectronic, semiconductor, and optical devices. Occasional. M&S fee: $30.00

EEE 5352 ECS-ECE 3(3,0)

EEE 5353 ECS-ECE 3(3,0)
Semiconductor Device Modeling and Simulation: PR: EEE 3307C. Large signal and small signal model development for semiconductor diodes, BJTs, and MOSFETs. Parameter extraction, numerical algorithm, and SPICE simulation are included. Spring.

EEE 5356C ECS-ECE 4(3,3)
Fabrication of Solid-State Devices: PR: EEE 3350. Fabrication of microelectronic devices, processing technology, ion implantation and diffusion, device design, and layout. Laboratory includes device processing technology. Fall, Spring. M&S fee: $45.00

EEE 5370 ECS-ECE 3(3,0)

EEE 5378 ECS-ECE 3(3,0)
CMOS Analog and Digital Circuit Design: PR: EEE 4309C. Advanced principles and design techniques for CMOS ICs including most recent published results. Fall.

EEE 5390 ECS-ECE 3(3,0)
Full-Custom VLSI Design: PR: EEE 3342C, EEE 3307C. CMOS VLSI design methodologies; full custom chip design, industrial CAD tools; simulation; verification. Spring.

EEE 6317. Power Semiconductor Devices and Integrated Circuits 3(3,0). PR: EEE 3350 or equivalent or C.I. Fundamental understanding of modern power semiconductor devices and integrated circuits (ICs) in relation to their applications in power electronics systems.
Spring.
ECS-Electrical & Computer Eng

EEE 6326C. MEMS Fabrication Laboratory
3(1,2). PR: CI. Silicon Nitride and Polysilicon Depositions, Photolithography, Dry and Wet etching processes, Metal depositions and etching, MEMS device design and fabrication.
Occasional.
ECS-Electrical & Computer Eng

EEE 6327. Design of Video Coding Systems
3(3,0). PR: EEL 4768C and EEL 4750. VLSI architectures and image/video coding algorithms, image/video coding standards, and architectural issues related with area/power/performance.
Spring.
ECS-Electrical & Computer Eng

EEE 6338. Advanced Topics in Microelectronics
3(3,0). PR: C.I. Covers advanced topics in microelectronics such as semiconductor device physics, semiconductor device fabrication, and semiconductor device modeling.
Occasional.
ECS-Electrical & Computer Eng

EEE 6371. Advanced Electronics I
Even Spring.
ECS-Electrical & Computer Eng

EEE 6372. Advanced Topics in Electronics
3(3,0). PR: EEE 6371 or C.I. Advanced and current topics in electronics such as power electronics and semiconductor integrated circuits.
Occasional.

ECS-Electrical & Computer Eng

EEE 6475. CMOS Analog and Digital Integrated Circuit Design
3(3,0). PR: EEE 4309C or C.I. The objective of this class is to teach the graduate students the principle and techniques of CMOS IC design for high performance, low power, and RF applications.
Fall.
ECS-Electrical & Computer Eng

EEL 3004 ECS-ECE 3(3,0)
Electrical Networks: PR: MAC 2311, MAC 2312, MAC 2313, PHY 2048, PHY 2049, CR: MAP 2302 (To enroll in this course, a C or better with a cumulative GPA of 2.7 or better for the above courses is required). Analysis and design of linear circuits, transients, ac analysis, power calculations, three-phase circuits, Laplace transform.
Fall, Spring.

EEL 3041 ECS-ECE 3(3,0)
Circuit Analysis: PR: PHY 2053C. Study of electrical networks. Circuit analysis techniques are presented, including DC and steady state analysis. Power calculations, power distribution and dissipation are covered with examples relating to cables, connections, and buses. Not open to EE and CpE majors. Fall, Spring.

EEL 3123C ECS-ECE 4(3,1)
Networks and Systems: PR: EEL 3004. Network functions, Laplace transforms, frequency domain analysis using Fourier series and transforms, sampling theory and $z$-transforms. Fall, Spring. M&S fee: $15.00
EEL 3470 ECS-ECE 3(3,0)
**Electromagnetic Fields:** PR: EEL 3004.
Electric and magnet fields and electromagnetic waves. *Fall, Spring.*

EEL 3531 ECS-ECE 3(3,0)
**Information Theory:** PR: STA 2023.

EEL 3552C ECS-ECE 4(3,3)
**Analog and Digital Communication Fundamentals:** PR: EEL 3123C.
Fundamentals of AM and FM, Baseband pulse and digital signaling, Bandpass signaling, digital modulation and detection, and error probability of simple digital systems. *Fall, Spring.* M&S fee: $15.00

EEL 3657 ECS-ECE 3(3,0)
**Linear Control Systems:** PR: EEL 3123C. Control theory, transfer function modeling, Nyquist criteria, root locus, Bode plots, and Design of lead and lag compensation. *Fall, Spring.*

EEL 3801C ECS-ECE 3(2,3)
**Computer Organization:** PR: COP 3223, EEE 3342C. Computer arithmetic, Instruction Set Architecture, performance, data path, control unit, memory hierarchy, I/O interface. *Fall, Spring.* M&S fee: $10.00

EEL 4050L ECS-ECE 1(0,3)
**EECS Integrated Laboratory:** PR: EEL 3552C,
EEL 3657, EEL 4750. Topics: Sampling, Digital FIR and IIR Filters, DSP processing of sound signals, transmitters and receivers based upon AM and FM, PID controller and feedback systems, and power conversion. *Occasional.*

EEL 4130 ECS-ECE 3(3,0)
**Fundamentals of Continuous Simulation:** PR: MAP 2302. Fundamental concepts of continuous system simulation. Numerical integration, math modeling, simulation software. May be repeated for credit. *Occasional.*

EEL 4140C ECS-ECE 4(3,3)
**Analog Filter Design:** PR: EEL 3123C. Passive and active analog filter design. *Fall.* M&S fee: $15.00

EEL 4205 ECS-ECE 3(3,0)
**Electric Machinery:** PR: EEL 3004 or C.I. Three-phase power representation and analysis, transformers, per unit system, symmetrical components, faults, and transmission lines. *Spring.*

EEL 4436C ECS-ECE 4(3,3)
**Microwave Engineering:** PR: EEL 3470. Transmission line theory, Smith charts, S-parameters, simple impedance matching circuits, wave guides, resonators, basic microwave measurements. May be repeated for credit. *Odd Fall.* M&S fee: $15.00
EEL 4440 ECS-ECE 3(3,0)
Optical Engineering: PR: EEL 3470, EEL 3552C or C.I. Lens systems, aberrations, sources, radiometry, detectors, physical optics, interferometric devices, applications to engineering design problems. Spring.

EEL 4512C ECS-ECE 4(3,3)
Communication Systems: PR: STA 3032, EEL 3552C and EEE 3307C. Information transmission, modulation, and noise; design and comparison systems in the presence of noise. Occasional. M&S fee: $15.00

EEL 4515C ECS-ECE 4(3,3)
Digital Communication Systems: PR: EEL 3552C. Sampling and quantization, PAM, PWM, PTM, PCM, and Delta Modulation ASK, FSK, PSK, MPSK, introduction to coding. Fall. M&S fee: $15.00

EEL 4518 ECS-ECE 3(3,0)
Satellite Communications: PR: EEL 3552C. The principles of satellite communications, including communications satellites, Earth stations, link analysis, FDMA and TDMA. May be repeated for credit. Fall.

EEL 4612 ECS-ECE 3(3,0)
Introduction to Modern and Robust Control:

EEL 4635C ECS-ECE 4(3,3)
Computer Control Systems: PR: EEL 3657. Discrete-time systems, the z-transform, and single loop computer control systems. Digital simulation in the analysis and design of processes with embedded computers. No graduate credit for both EEL 5630 and this course. Occasional. M&S fee: $15.00

EEL 4742C ECS-ECE 4(3,3)
Embedded Systems: PR: EEL 3801. Microcontroller systems, assembly language programming, data representation, memory and device interfacing, timing analysis, parallel and serial communication, timers, interrupts, signal interfacing considerations, and applications. Fall, Spring. M&S fee: $30.00

EEL 4750 ECS-ECE 3(3,0)

EEL 4768C ECS-ECE 4(3,3)
Computer Architecture: PR: EEL 3801 or CDA 3103. Computer systems performance and evaluation, processor datapath and control, microprogrammed architectures, instruction and arithmetic pipelines, cache and virtual memory, and RISCvs. CISC. Fall, Spring. M&S fee: $30.00

EEL 4781 ECS-ECE 3(3,0)
protocols. Data link control. Routing and flow control.
Internetworking. Current architectures and protocols: OSI, ethernet, token, ring, FDDI, HSLC, X.25, etc. Fall, Spring.
EEL 4783 ECS-ECE 3(3,0)
Hardware Description Languages in Digital Systems Design: PR: EEE 3342C.
Hardware description languages, simulation and synthesis of RTL circuits and systems, design examples and projects. Occasional.
M&S fee: $5.00
EEL 4791 ECS-ECE 3(2,4)
Telemetry and Space Computer Systems: PR:
EEL 3552C and EEL 3801C, EEL 3657, EEE 3307C, EEL 3470. Telemetry and computer sub-systems are discussed as they are implemented in the space-launch system “inertial upper stages”. Occasional.
EEL 4817H ECS-ECE 3(3,0)
Honors Current Topics in Machine Learning II: PR: Consent of Honors and EEL 4818H. Research topics in Machine Learning. Students will be assigned a research project and a faculty mentor who will supervise this project. Spring.
EEL 4818H ECS-ECE 3(3,0)
Honors Current Topics in Machine Learning I: PR: Consent of Honors and EEL 3801 or COP 3223 or STA 3032 or C.I. Machine Learning and Applications.
ART Neural Networks, Genetic Algorithms, Decision Trees, Evolutionary Hardware, Evolutionary Neural Networks, and Reinforcement Learning. Fall.
EEL 4832 ECS-ECE 3(3,0)
Engineering Applications of Computer Methods: PR: MAP 2302, STA 3032, EGN 3420.
Engineering applications of numerical methods, including solution of differential equations, simulation, optimization, and multidimensional root-finding, integration and series approximations. Fall, Spring.
EEL 4851C ECS-ECE 4(3,3)
Engineering Data Structures: PR: EEL 3801C.
Design of data structures and algorithms, with emphasis on performance analysis, memory organization, stacks, queues, linked lists, trees, graphs, searches, and sorts. Introduction to object-oriented structures. Fall, Spring. M&S fee: $5.00
EEL 4872 ECS-ECE 3(3,0)
Engineering Applications of Intelligent Systems: PR: EEL 4851C or COP 3503C or equivalent or C.I. Knowledge and intelligence, predicate logic and automated reasoning, heuristic search, knowledge representation, automated planning, introduction to machine learning, knowledge-based systems and philosophy of AI.
Occasional.
EEL 4882 ECS-ECE 3(3,0)
Engineering Systems Software: PR: EEL 4851C and EEL 4742C. Introduction to operating systems concepts...
and facilities for engineering applications, including multiprogramming, resource allocation and management, systems utilities, and operating system implementation. *Fall, Spring.*

**EEL 4884C ECS-ECE 4(3,3)**

**Engineering Software Design:** PR: EEL 4851C.
Software systems development life cycle, function and object-oriented methodologies, CASE; Analysis, design, and development of a large software project. *Fall, Spring.*
M&S fee: $5.00

**EEL 4890 ECS-ECE 3(3,0)**

**Continuous System Simulation I:** PR: MAP 2302.
Numerical integration techniques and discrete time system models for approximating the dynamics of continuous systems. *Occasional.*

**EEL 4914 ECS-ECE 3(3,0)**

**Senior Design I:** PR: EEE 3307C, EEL 4742C, and consent of School of EECS.
Applications of engineering design to realistic and meaningful problems. Constraints such as economic factors, safety, reliability, aesthetics, ethics, social impact and engineering organizations are considered. *Fall, Spring.*

**EEL 4915L ECS-ECE 3(0,3)**

**Senior Design II:** PR: EEL 4914.
Execution of electrical and computer engineering project including complete project design review, construction, testing and demonstration. Emphasis on design, prototyping, cost, functionality, presentation, team effort and final report. *Fall, Spring.*
M&S fee: $15.00

**EEL 5173 ECS-ECE 3(3,0)**

**Linear Systems Theory:** PR: EEL 3657.
Models and properties of linear systems, transformation, controllability and observability, control and observer designs, MFD, and realization theory. *Spring.*

**EEL 5245C ECS-ECE 3(2,1)**

**Power Electronics:** PR: EEE 4309C.
Principles of power electronics, power semiconductor devices, inverter topologies, switch-mode and resonant dc-to-dc converters, cyclo-converters, applications. *Fall.*

**EEL 5272 ECS-ECE 3(3,0)**

**Biomedical Sensors:** PR: EEL 4750 or EEL 4832 or C.I.
Study of engineering concepts behind the various biomedical sensors used to monitor a patient undergoing clinical therapy. *Occasional.*

**EEL 5432 ECS-ECE 3(3,0)**

**Satellite Remote Sensing:** PR: EEL 3470 or PHY 4324.
Fundamentals of satellite remote sensing, orbits and geometry, radiative transfer theory, microwave and infrared sensing techniques, ocean, ice and atmosphere geophysical measurements. *Occasional.*

**EEL 5437C ECS-ECE 4(3,3)**

**Microwave Engineering:** PR: EEL 3470 or C.I.
Transmission line theory, Smith charts, S-parameters, simple impedance matching circuits, wave guides, resonators,
basic microwave measurements. Even Fall. M&S fee: $15.00

**EEL 5439C ECS-ECE 3(2,1)**
RF and Microwave Communications: PR: EEL 4436C or equivalent. RF and microwave active circuits microstrip amplifier, oscillator, and mixer design and fabrication. Receiver design, noise, familiarization with network and spectrum analyzers. Occasional. M&S fee: $30.00

**EEL 5462C ECS-ECE 3(3,1)**
Antenna Analysis and Design: PR: EEL 3470 or equivalent. Fundamentals of antennas; dipoles, loops, arrays, apertures, and horns. Analysis and design of various antennas. Odd Fall. M&S fee: $5.00

**EEL 5482 ECS-ECE 3(3,0)**
Electromagnetic Theory I: PR: Graduate standing or C.I. Maxwell’s equations, boundary conditions, propagation and reflection, guided waves. Occasional.

**EEL 5513 ECS-ECE 3(3,0)**

**EEL 5517 ECS-ECE 3(3,0)**
Surface Acoustic Wave Devices and Systems: PR: EEL 3552C. Course discusses SAW technology which includes the physical phenomenon, transducer design and synthesis, filter design and performance parameters. Actual devices and communication systems are presented. Occasional.

**EEL 5542 ECS-ECE 3(3,0)**

**EEL 5547 ECS-ECE 3(3,0)**

**EEL 5625 ECS-ECE 3(3,0)**
Applied Control Systems: PR: C.I. Designed to develop basic understanding of advanced control methods for nonlinear systems described by ordinary and partial differential equations and to expose recent results and ongoing research issues in the area of MEMS. Occasional.

**EEL 5630 ECS-ECE 3(3,0)**

**EEL 5669 ECS-ECE 3(3,0)**
Autonomous Robotic Systems: PR: EEL 3657 or C.I. Introduction to robotics, with emphasis on kinematics, dynamics, trajectory planning, regulation and tracking,
formation control, and cooperative rules and behaviors of robotic vehicles. *Odd Fall.*

**EEL 5704 ECS-ECE 3(3,0)**

**Computer Aided Logical Design:** PR: EEL 4742C. Design, analysis and synthesis of sequential logic circuits and systems. Data path and controller design using a hardware description language. *Occasional.*

**EEL 5722C ECS-ECE 3(3,1)**

**Field-Programmable Gate Array (FPGA) Design:** PR: EEE 3342C or C.I. FPGA architectures, design flow, technology mapping, placement, routing, reconfigurable computing applications, and evolvable hardware. *Even Fall.*

**EEL 5771C ECS-ECE 3(2,3)**

**Engineering Applications of Computer Graphics:** PR: EGN 3420 or C.I. Computer graphics in engineering applications. Laboratory assignments. *Occasional.* M&S fee: $5.00

**EEL 5780 ECS-ECE 3(3,0)**

**Wireless Networks:** PR: EEL 4781 or C.I. The wireless networking topics include: cellular networks, multiple access protocols, channel assignment and resource allocation, mobility and location management, handoffs, routing, authentication, call admission control and QoS provisioning, network layer issues, wireless data networking (WAP, GSM, GPRS, CDMA, WCDMA.). *Even Spring.*

**Image Processing:** PR: MAP 2302, EGN 3420, EEL 4750 or C.I. Two-dimensional signal processing techniques; pictorial image representation; spatial filtering; image enhancement and encoding; segmentation and feature extraction; introduction to image understanding techniques. *Odd Spring.*

**EEL 5825 ECS-ECE 3(3,0)**

**Pattern Recognition:** PR: EGN 3420 or C.I. Preliminaries of pattern recognition, Bayesian Decision Theory, linear discriminant functions, Neural Network approaches, decision tree classifiers, unsupervised learning and clustering, non-parametric techniques, and other topics reflecting the state-of-the art. *Occasional.*

**EEL 5860 ECS-ECE 3(3,0)**

**Software Requirements Engineering:** PR: Graduate standing or C.I. Excellent oral and written communication skills. Excellent problem solving skills. In-depth study of software requirements engineering within a process centered framework. Methods for requirements elicitation, analysis, description, and validation. Formal and informal specification. *Occasional.*

**EEL 5874 ECS-ECE 3(3,0)**

**Expert Systems and Knowledge Engineering:** PR: EEL 4872 or CAP 4630 C.I. Introduction to expert systems in engineering. Expert systems tools and interviewing
techniques. This course is hands-on and project oriented.

*Spring.*

**EEL 5881 ECS-ECE 3(3,0)**
**Software Engineering I:** PR: EGN 3420, EEL 4851C or C.I. Design, implementation, and testing of computer software for Engineering applications. *Fall, Spring.*

**EEL 5892 ECS-ECE 3(3,0)**

**EEL 5936 ECS-ECE 0(1,0)**
**Current Topics in EECS:** PR: Open to all ECE graduate students. Lectures presented by ECE and national lectures will provide our students a broad view of the state of the art EE and CE fields. Graded S/U. *Occasional.*

**EEL 6026. Optimization of Engineering Systems**
3(3,0). PR: Graduate standing and C.I. A unified treatment of optimization methods often used to solve problems in engineering and applied sciences. Software packages are used when appropriate. *Occasional.*

**ECS-Elec trical & Computer Eng**

**EEL 6208. Advanced Machines**
3(3,0). PR: EEL 4205. Theory of electric machines using reference frame transformations: Basic principles of dc and ac machines, including induction and synchronous, are included. Simulation techniques for steady state and dynamic performance analysis will be used to analyze operation of electric machines with solid state drives. Occasional.

**ECS-Electrical & Computer Eng**

**EEL 6246. Power Electronics II**
3(3,0). PR: EEL 5245C. Advanced topics in power electronics, soft-switching techniques, small-signal modeling of PWM and resonant converters, control techniques, power factor correction circuits. Occasional.

**ECS-Electrical & Computer Eng**

**EEL 6255. Advanced Power Systems Analysis**
3(3,0). PR: EEL 4216 or C.I. Continuation of EEL 4216. Topics to include symmetrical and unsymmetrical fault analysis, power system estimation and control and power system stability. Occasional.

**ECS-Electrical & Computer Eng**

**EEL 6269. Advanced Topics in Power Engineering**
3(3,0). PR: EEL 6255. A current topic will be discussed such as power system transients, system protection, T&D, and dielectric engineering. Occasional.

**ECS-Electrical & Computer Eng**

**EEL 6318. Semiconductor Material and Device Characterization**
3(3,0). PR: EEE 4314 or C.I. Semiconductor materials, resistivity, mobility, doping, carrier lifetime, defects, contact resistance, threshold voltage, interface charges, channel length of MOS devices, optical and surface characterization. Odd Fall.

**ECS-Electrical & Computer Eng**

**EEL 6358. Advanced Semiconductor Device I***
3(3,0). PR: EEE 3350. First course in advanced semiconductor device physics and modeling. Main stream devices including junctions diode, bipolar transistor, and metal-oxide field-effect transistor. Spring. ECS-Electrical & Computer Eng

**EEL 6425C. RF and Microwave Measurement Techniques**
4(3,3). PR: EEL 4436C or EEL 5482 or EEL 5439C or C.I. RF and Microwave components in wireless systems; i.e., antennas, passive components, active circuits, as well as noise, modulation are characterized by measurement and designed/verified by EM/circuit software. Fall. ECS-Electrical & Computer Eng

**EEL 6463. Antenna Analysis and Design II**
3(3,0). PR: EEL 5462C. Aperture antennas, reflectors, and microstrip antennas. Even Spring. ECS-Electrical & Computer Eng

**EEL 6481. Numerical Techniques in Electromagnetics**
3(3,0). PR: EEL 6488 or C.I. Applications of finite difference methods (FDTD), finite element method, integral equation method (method of moments) to electromagnetics. Occasional. ECS-Electrical & Computer Eng

**EEL 6488. Electromagnetic Theory II**
3(3,0). PR: EEL 5482 or C.I. Scattering, diffraction, Green's function, and method of moments. Occasional. ECS-Electrical & Computer Eng

**EEL 6489. Advanced Topics in Electromagnetics and Microwaves**
3(3,0). PR: C.I. Advanced and current topics in EM fields, antennas, and microwaves. Occasional. ECS-Electrical & Computer Eng

**EEL 6502. Adaptive Digital Signal Processing**
3(3,0). PR: EEL 5513 or C.I. Weiner filtering, Least Mean Square and Recursive Least Squares based algorithms, adaptive prediction and identification with applications such as echo cancellation, etc. Spring. ECS-Electrical & Computer Eng

**EEL 6504. Communications Systems Design**

**EEL 6505. Multidimensional Digital Processing**
3(3,0). PR: EEL 5513 or C.I. Multidimensional signals and systems. Two-dimensional transforms and filters. Image processing applications. Occasional. ECS-Electrical & Computer Eng

**EEL 6530. Communication Theory**
3(3,0). PR: EEL 5542 or C.I. Communication in the presence of noise; analog and pulse modulation; use of phase-locked loops, synthesizers, VCOs, system implementations. Spring. ECS-Electrical & Computer Eng

**EEL 6532. Information Theory and Coding**
3(3,0). PR: EEL 5542 or C.I. Concepts regarding information: Covers entropy, channel capacity, Shannon's theorems,
Fano’s inequality, coding theory, linear, Hamming, and cyclic codes, Hamming, Singleton, Gilbert-Varshamov, and Plotkin Bounds.
Spring.
ECS-Electrical & Computer Eng

EEL 6537. Detection and Estimation
3(3,0). PR: EEL 6543. Use of hypothesis testing (Bayes, Minimax, Neyman-Pearson) and estimation theory (Bayes, Maximum-likelihood) for detecting or estimating signals in noise. Application in communications and radar. Occasional.
ECS-Electrical & Computer Eng

EEL 6543. Random Processes II
ECS-Electrical & Computer Eng

EEL 6558. Advanced Topics in Digital Signal Processing
3(3,0). PR: C.I. Advanced and current topics in digital signal processing, such as neural network, spectral analysis, and speech processing. Occasional.
ECS-Electrical & Computer Eng

EEL 6564. Statistical Optics with Applications
3(3,0). PR: OSE 5041 and EEL 5542, or C.I. Characterization of random optical waves with applications in communications, turbulence scattering, and imaging. Occasional.
ECS-Electrical & Computer Eng

EEL 6590. Advanced Topics in Communications
3(3,0). PR: C.I. Advanced and current topics in communications, such as coding theory, information theory, spread spectrum, etc. Occasional.
ECS-Electrical & Computer Eng

EEL 6616. Adaptive Control
ECS-Electrical & Computer Eng

EEL 6617. Fundamentals of Modern Multivariable Control
ECS-Electrical & Computer Eng

EEL 6619. Nonlinear Robust Control and Applications
ECS-Electrical & Computer Eng

EEL 6621. Nonlinear Control Systems
3(3,0). PR: EEL 5173. Phase plane descriptions of nonlinear phenomena, limit cycles, jump conditions, stability, describing functions, Liapunov and Popov theory, time and frequency domain analysis for nonlinear systems. Even Fall.
ECS-Electrical & Computer Eng

EEL 6662. Design of Robot Control Systems
3(3,0). PR: EEL 5173. Coordinate transformation, differential equation of motion, trajectory planning, trajectory control, classical controls, advanced
controls, force control, constrained motions, and redundancy.
Occasional.
ECS-Electrical & Computer Eng

EEL 6667. Planning and Control for Mobile Robotic Systems
3(3,0). PR: EEL 5173 or EEL 5630. Non-holonomic systems, kinematics and dynamics, trajectory planning and obstacle avoidance, canonical terms, control design, stability, performance, and robustness. Occasional.
ECS-Electrical & Computer Eng

EEL 6671. Modern and Optimal Control Systems
ECS-Electrical & Computer Eng

EEL 6674. Optimal Estimation for Control
3(3,0). PR: EEL 5173 or C.I. Optimal filtering, smoothing, and prediction methods are analyzed with applications to a number of linear and nonlinear dynamic systems. Occasional.
ECS-Electrical & Computer Eng

EEL 6680. Advanced Topics in Modern Control Systems
3(3,0). PR: C.I. Introduces students to present-day issues in control systems analysis, design, and implementation. Occasional.
ECS-Electrical & Computer Eng

EEL 6683. Cooperative Control of Networked Autonomous Systems
3(3,0). PR: EEL 5173 or C.I. Fundamentals of cooperative control theory for autonomous vehicles and agents, with emphasis on consensus, effects of intermittent and delayed communication/sensing network, and cooperative control designs. Odd Fall.
ECS-Electrical & Computer Eng

EEL 6762. Performance Analysis of Computer and Communication Systems
3(3,0). PR: EEL 4742C and STA 3032 or C.I. Stochastic modeling and discrete-event simulation; Markov chains; networks of queues; SemiMarkov models; application to multiprocessor systems, switching and multi-user communications. Occasional.
ECS-Electrical & Computer Eng

EEL 6769. Parallel Knowledge Processing Systems
3(3,0). PR: EEL 6762 and EEL 5874 or C.I. Design and performance of computer architectures supporting parallel reasoning techniques, including concurrency in search algorithms, genetic algorithms, semantic networks, marker-propagation, and rule-based systems. Occasional.
ECS-Electrical & Computer Eng

EEL 6785. Computer Network Design
3(3,0). PR: EEL 4768C or C.I. Network types and network protocols. Design of networks and analysis of their performance. Fall.
ECS-Electrical & Computer Eng

EEL 6788. Advanced Topics in Computer Networks
3(3,0). PR: EEL 4781 or C.I. Advanced topics in the networking field, driven by the latest research and technology developments.
ECS-Electrical & Computer Eng

EEL 6812. Introduction to Neural Networks
3(3,0). PR: EEL 5825 or C.I.

Spring.

ECS-Electrical & Computer Eng

EEL 6823. Image Processing II
3(3,0). PR: EEL 5820 or C.I. Advance topics in image processing: nonlinear and adaptive filtering morphological processing, color image processing, texture analysis, and image encoding.

Occasional.

ECS-Electrical & Computer Eng

EEL 6843. Machine Perception
3(3,0). PR: EEL 5820 or EEL 5825 or C.I. Advanced methods of machine understanding; simulation of intelligent machine systems; automatic recognition systems; visual tracking systems; multispectral feature analysis.

Occasional.

ECS-Electrical & Computer Eng

EEL 6845. Intelligent Control
3(3,0). PR: C.I. Design and development of intelligent machine systems; decision theory; intelligence modeling; neural models; advanced techniques in intelligent control.

Occasional.

ECS-Electrical & Computer Eng

EEL 6865. Architecture and Design of Software Intensive Systems
3(3,0). PR: Graduate standing or C.I.; and EEL 4851C or equivalent; and EEL 4884C or EEL 5881. In depth study of software architecture and design of engineering complex software-intensive systems. Theory and practice.

Occasional.

ECS-Electrical & Computer Eng

EEL 6875. Autonomous Agents
3(3,0). PR: EEL 4872 or CAP 4630 or C.I. Agent architectures, including behavioral, decision theoretic and logic (BDI) based. Multi-agent systems, agent communication languages. Negotiation, argumentation, coalition formation. Project oriented.

Occasional.

ECS-Electrical & Computer Eng

EEL 6876. Current Topics in Artificial Intelligence
3(3,0). PR: EEL 4872 or CAP 4630 or C.I. Review of the state-of-the-art research in selected current topics in artificial intelligence. Includes extensive review of current literature and class discussion.

Occasional.

ECS-Electrical & Computer Eng

EEL 6878. Modeling and Artificial Intelligence
3(3,0). PR: EEL 4872 or CAP 4630 or C.I. Introduction to artificial intelligence techniques applied to computer-based modeling, simulation, and training.

Occasional.

ECS-Electrical & Computer Eng

EEL 6883. Software Engineering II
3(3,0). PR: EEL 5881 or equivalent; C.I. Continuation of EEL 5881. Emphasis on term projects and case studies.

Spring.

ECS-Electrical & Computer Eng

EEL 6885. Software Engineering Quality Assurance Methods
3(3,0). PR: EEL 5881, EEL 6883. Methods for verification and validation of software quality, including software engineering metrics and models.

Occasional.

ECS-Electrical & Computer Eng
EEL 6886. Software Testing Theory
3(3,0). PR: Graduate standing or C.I.; and Probability and Statistics; Calculus through Differential Equations; Numerical Methods and Matrix Algebra; Data Structures and Algorithms; C or C++ programming. Issues and current research in testing software-intensive systems. Application of mathematics, statistics, and operations research to software test; test automation; projects and analysis of literature. Occasional.
ECS-Electrical & Computer Eng

EEL 6887. Software Engineering Life-Cycle Control
3(3,0). PR: EEL 5881, EEL 6883. Issues in software development life-cycle control including project cost and time estimation, methods and models, manpower allocation, and system configuration management. Spring.
ECS-Electrical & Computer Eng

EEL 6893. Advanced Topics in Continuous Simulation
ECS-Electrical & Computer Eng

EEL 6895. Current Issues in Real-Time Simulation
3(3,0). PR: EEL 5771C, EEL 5892. Design considerations in real-time, computer-based, training simulator systems. Laboratory assignments. Occasional.
ECS-Electrical & Computer Eng

EEL 6897. Software Development for Real-Time Engineering Systems
3(3,0). PR: EEL 5881, EEL 6883. Issues associated with developing software for real-time systems, including parallel processing, task synchronization, and task scheduling. Occasional.
ECS-Electrical & Computer Eng

EGN 3373 ECS-ECE 3(3,0)
Principles of Electrical Engineering:
PR: PHY 2049C; CR: MAP 2302. Fundamentals of electrical circuits and analysis; fundamentals of electronics and AC power systems, transformers, electromechanics and rotating machines. Fall, Spring.

EGN 3373H ECS-ECE 3(3,0)
Principles of Electrical Engineering Honors:

EGN 3420 ECS-ECE 3(3,0)
Engineering Analysis: PR: High-level computer language; MAC 2312. Engineering applications of numerical methods including curve fitting, matrix operations, root finding, interpolating, integration and plotting. Fall, Spring.