ME 482	Fluid and Thermal Systems Design (4)	
ME 486	Mechanical Systems Design (4)	
ME 487	Mechanical Computer-Aided Engineering(4)	
		12

Technical electives, choose 6 to 8 credits from:

MTH 275	Linear Algebra (4)	
APM 263	Discrete Mathematics (4)	
PHY 318	Nuclear Physics Laboratory (2)	
PHY 331	Optics (4)	
PHY 366	Vibrations and Waves (4)	
PHY 372	Nuclear Physics (4)	
PHY 381	Electricity and Magnetism I (4) or	
PHY 418	Modern Optics Laboratory (2)	
PHY 472	Quantum Mechanics I (4)	
PHY 482	Electricity and Magnetics II (4)	
ECE 352	Electromagnetics and Electromechanisms (4)	
ECE 378	Digital Logic and Microprocessor Design (4)	
ECE 384	Electronic Materials and Devices (4)	
ME 331	Introduction to Fluid and Thermal Energy Transport (4)	
ME 361	Mechanics of Materials (4)	
Any 400-level ECE, ME or ISE courses (4-8)		
		6-8

Free electives (may be used to satisfy writing requirement)	4-6
	Total 128

Performance requirements

In addition to the previously stated requirements, satisfactory completion of the program requires an average grade of at least 2.00 in the engineering and computer science courses and also in the mathematics and science courses taken to meet program requirements.

Course Offerings

Courses offered through the School of Engineering and Computer Science carry the following designations: information technology courses, CIT; computer science and engineering courses, CSE; electrical and computer engineering courses, ECE; industrial and systems engineering courses, ISE; mechanical engineering courses, ME. Courses offered under the general title of engineering are listed under EGR. For some of the courses, the semester(s) in which they are usually offered is indicated at the end of the course description. However, this is subject to change. To register for 300- and 400-level courses, students must have attained major standing.

ENGINEERING

EGR 120 Engineering Graphics and CAD (1)
An introduction to the techniques for creating solid models of engineering designs. Topics include three-dimensional modeling of parts and assemblies, visualization, orthographic project views and layouts, auxiliary, sectional, and cutout views, exploded views, dimensioning and tolerancing, bill of materials, and computer-generated design documentation. Offered fall, winter.

EGR 141 Computer Problem Solving in Engineering and Computer Science (4)
General methods of problem solving and principles of algorithmic design using a high-level language such as Visual Basic .NET. Introduction to MATLAB. Applications will be drawn from problems in mechanical, electrical and computer engineering and computer science. Offered fall, winter.
Corequisite: MTH 154 or equivalent.

EGR 240 Introduction to Electrical and Computer Engineering (4)
An introduction to the fundamentals of electrical and computer engineering; DC and AC circuits; digital logic circuits, combinational logic design, sequential circuits, introduction to electronics, operational amplifiers, DC electromechanical machines. With laboratory. Offered fall, winter.
Prerequisite: EGR 141.
Prerequisite or Corequisite: MTH 155, PHY 151.

EGR 250 Introduction to Thermal Engineering (4)
Introduction to the fundamentals of classical thermodynamics and heat transfer; first and second laws of thermodynamics, thermodynamic property relationships, application to engineering systems and processes, steady and transient conduction in solids, introduction to convection heat transfer correlations. Repeat course for ME 241. Offered fall, winter.
Prerequisite: CHM 143 (or 157), EGR 141, APM 255 (or 257), MTH 256 (or APM 257), MTH 275, PHY 151.
Corequisite: APM 255 (or 257), MTH 256 (or APM 257) and MTH 275.

EGR 260 Introduction to Industrial and Systems Engineering (4)
Overview of industrial and systems engineering: perspectives, tools and models. In depth coverage of probability and statistics in engineering: density and distribution functions, population and sampling distributions, confidence intervals, hypothesis testing and introduction to discrete-event simulation. Offered fall, winter.
Prerequisite: EGR 141, MTH 155.

EGR 280 Design and Analysis of Electromechanical Systems (4)
Design, analysis, and testing of electromechanical systems; statics, linear and rotational dynamics; introduction to microprocessors, team design project dealing with technical, economic, safety, environmental, and social aspects of a real-world engineering problem; written, oral, and visual communication, engineering ethics. Offered fall, winter.
Prerequisite: EGR 120, 240.
Corequisite: EGR 250, 260.

EGR 295 Special Topics (1 to 4)
Study of special topics in engineering and/or computer science. May be taken more than once. Topic must be approved prior to registration.

EGR 400 Engineering Seminar (1)
Lectures and discussions conducted by faculty, graduate students and speakers from industry and other universities. Emphasis is on current research interests of the school. May be taken twice.

EGR 491 Capstone Design (3-4)
Multi-disciplinary team experience in design, emphasizing realistic constraints such as safety, economic factors, reliability, aesthetics, ethics and societal impact. Projects will be supervised by the faculty. Offered fall, winter.
Prerequisite: senior standing.

EGR 496 International Engineering and Computer Science (4)
An independent study or technical internship involving a minimum of eight weeks of residence abroad; student is required to present a final report. Departmental approval is required prior to registration.
Prerequisite: senior standing.

ENGINEERING BIOLOGY

EGB 390 Introduction to Engineering Biology (3)
This course is a survey of topics and careers in engineering biology. It aims to help students choose their track for the remainder of the program and gain a general view of the field. Topics include bioinformatics, computational biology, electronic devices, biosensors, biomedical and biophysical engineering, and quantitative biology.
Prerequisite: major standing.

EGB 490 Research Project/Capstone Design (3)
Students integrate multi-disciplinary knowledge and the various skills in laboratory work and communication, to solve problems using engineering biology principles under real world constraints. Students will present project proposals to the faculty advisory panel, demonstrate feasibility, implement the projects, present the final projects, and compete for best project.
Prerequisite: major standing and senior status.

INFORMATION TECHNOLOGY

CIT 120 Introduction to Computing and Programming using Excel (4)
An introduction to computers and programming. It introduces algorithms for applications that contain integrated development environments (IDE), such as Microsoft Excel's IDE for Visual Basic for Applications (VBA). Algorithmic topics include repetitive and decision structures, functions, subroutines, and ActiveX controls. Programming topics include application automation and presenting information programmatically. Laboratory. *Satisfies the university general education requirement in the formal reasoning knowledge foundation area.* (Cross-listed with CSE 120.)

CIT 122 Computer Animation (4)
Computer animation is an increasingly critical component of human-computer-interaction, computer games, movie industry, and scientific and engineering visualization. This course covers the fundamental concepts underlying animation, discusses the characteristics and constraints of the different techniques and how they fit together, and teaches students the skills to create animations and computer games. This course is lab-intensive. Offered fall, winter. *Satisfies the university general education requirement in the formal reasoning knowledge foundation area.*

CIT 130 Introduction to Computer Programming (4)
Introduction to digital computers and algorithmic programming. Topics include: data storage and manipulation, control structures, functions and sub-programming. Introduction to object-oriented programming. Students cannot receive credit for both EGR 141 and this course. Offered fall, winter. (Cross-listed with CSE 130). *Satisfies the university general education requirement in the formal reasoning knowledge foundation area.*
Prerequisite: MTH 012 or equivalent.

CIT 220 Spreadsheet Programming and Reporting (4)
Introduction to business applications using Visual Basic. Emphasis is on structured programming for automating word processing and spreadsheet applications including creating reports using a report writer for database record sets from integrated business applications. Topics include Office Automation events, properties, methods, and programming techniques. *Satisfies the university general education requirement in the*

knowledge application integration area. Prerequisite for knowledge application: completion of the general education requirement in the formal reasoning knowledge foundation area. (Cross-listed with CSE 220).
Prerequisite: CIT 120 or CSE 120 or CIT 130 or CSE 130 and MTH 122 or MTH 154 or equivalent.

CIT 230 Introduction to Object-Oriented Programming (4)
Introduction to object-oriented computer programming using a high-level programming language such as Java. Classes, member functions, inheritance, polymorphism and operator overloading. Design methodologies and introduction to software engineering principles and practices. Basic data structures, algorithms and event driven programming concepts are introduced. (Cross-listed with CSE 230).
Prerequisite: CIT 130 or CSE 130 or CSE 142 or equivalent.

CIT 247 Introduction to Computer Networks (4)
An introduction to fundamental concepts for design and analyses of computer networks. Topics covered include the Internet, network protocols, Local Area Networks (LAN), wireless and mobile networks, network security, and socket programming. (Cross-listed with CSE 247).
Prerequisite: high level programming course or CIT 230 or CSE 230.

CIT 248 Computer Systems (4)
Introduction to computer systems. Topics cover computer system components including hardware components, storage devices, memory, graphics accelerators, communications interfaces, and CISC and RISC processors, operating system, concepts including Unix. Issues in cost, performance, security, and compatibility and benchmarking.
Prerequisite: CIT 230 or CSE 230 or equivalent.

CIT 252 Interactive Web Systems (4)
This course introduces the fundamentals of interactive multimedia in context of web technologies. Topics covered include use of modern web development tools, Markup Languages, server-side processing, and client-side processing using languages such as JavaScript. Students will use these tools to create interactive and dynamic web sites. *Satisfies the university general education requirement in the knowledge applications integration area. Prerequisite for knowledge applications: completion of the general education requirement in the formal reasoning knowledge foundation area.*
Prerequisite: CIT 122 or CIT 130 or CSE 130.

CIT 280 Sophomore Project (2)
A team-oriented project work consisting of a small project to build skills in needs assessment, group problem solving, and written and oral technical presentations.
Prerequisite: CIT 230 or CSE 230.

CIT 337 Software Engineering and Practice (4)
Introduction to software engineering and practice. Topics include software process models, project management, requirements analysis, software quality assurance, and testing.
Prerequisite: major standing in IT/CS.

CIT 345 Database Design and Implementation (4)
Introduction to the design and implementation of database systems. Include designing a practical database for an application using normal forms, understanding relational database schemas, planning and implementing a database using software such as Oracle and Microsoft SQL Server, advanced database topics in redundancy, replication, load balancing, compatibility, ODBC and JDBC, and database systems administration. (Cross-listed with CSE 345).
Prerequisite: major standing in IT.

CIT 348 System Administration (4)
This course teaches the skills necessary to analyze, deploy, manage and troubleshoot enterprise computing infrastructures. Topics include user authentication management, system configuration and

management, period tasks automation, network file systems and data backup techniques, server deployments, and system performance analysis techniques. The course has a significant lab component.
Prerequisite: CIT 247 or CSE 247 and major standing in CS/IT.

CIT 349 Advanced System Administration (4)
Advanced concepts in enterprise computing infrastructure analysis, deployment, management and troubleshooting. Topics include enterprise computing resource requirements analysis and design, single sign-on management, application and server deployment, virtualization, security configurations, and performance analysis.
Prerequisite: CIT 348 and major standing in CS/IT.

CIT 350 Human Computer Interaction (4)
Surveys various components, techniques of Human Computer Interaction (HCI). Topics include the basic perceptual, cognitive and performance capabilities of people and external factors that affect these capabilities, tools, techniques for understanding, predicting, evaluating the interactions of people with technology. Systematic processes for designing, evaluating and revising interactive systems are studied.
Prerequisite: major standing in IT/CS.

CIT 352 Systems Analysis (4)
Introduction to pervasive themes in information technology. Topics include history of information systems, information management, complexity management, methodologies for information centric requirements analysis, work flow analysis, and tools for system analysis.
Prerequisite: major standing in IT.

CIT 402 Professional Practice (2)
Seminars on software piracy, hacking, privacy, professional conduct and the impact of information technology on society.
Prerequisite: major standing.

CIT 448 Information Security Practice (4)
Survey of concepts and methods of security policies, models, and mechanisms for secrecy, integrity, availability, and authentication. Topics covered include security policies; access control; introduction to cryptography; control and prevention of viruses and other rogue programs; common system vulnerabilities and countermeasures; and legal and social issues.
Prerequisite: CIT 247 or CSE 247 and major standing in CS/IT.

CIT 450 CIT Project Management (4)
This course presents the theory and practice of IT project management. Topics include financial modeling, cost and effort estimation, project risk management, and project evaluation and selection as well as topics in IT project sponsorship, stewardship and leadership. IT entrepreneurship and marketing are emphasized throughout the course.
Prerequisite: CIT 352 and major standing in IT.

CIT 480 Senior Capstone Project (4)
A team-oriented senior project to synthesize the knowledge and skills gained in the CS/IT curricula. Written and oral reports are required in addition to a working demo. (Cross-listed with CSE 480). *Satisfies the university general education requirements for the capstone experience. Satisfies the university general education requirement for a writing intensive course in the major. Prerequisite for writing intensive: completion of the university writing foundation requirement.*
Prerequisite: CIT 337, 345 and senior standing in IT.

CIT 495 Special Topics (2 to 4)
Advanced study of special topics. May be taken more than once.
Prerequisite: major standing.

CIT 496 Internship (4)
The student works on a specific project at a corporate site with the prior approval by the program director. Oral and written presentations about the project are required.
Prerequisite: major standing.

CIT 497 Industrial Project (4)
The student works on a specific project at a corporate site with the prior approval by the program director. Oral and written presentations about the project are required.
Prerequisite: major standing.

CIT 498 Undergraduate Research (4)
The student performs research under the supervision of a faculty member. Prior permission required. Oral and written presentations about the research are required.
Prerequisite: major standing.

COMPUTER SCIENCE AND ENGINEERING

CSE 110 Computer Literacy (2)
An introduction to the use of desktop computers. Topics include word-processing, spreadsheets, PowerPoint and the use of the worldwide web.

CSE 120 Introduction to Computing and Programming using Excel (4)
An introduction to computers and programming. It introduces algorithms for applications that contain integrated development environments (IDEs) such as Microsoft Excel's IDE for Visual Basic for Applications (VBA). Algorithmic topics include repetitive and decision structures, functions, subroutines, and ActiveX controls. Programming topics include application automation and presenting information programmatically. Accompanied by laboratory sessions. Offered fall, winter. (Cross-listed with CIT 120). *Satisfies the university general education requirement in the formal reasoning knowledge foundation area.*

CSE 130 Introduction to Computer Programming (4)
Introduction to digital computers and algorithmic programming. Topics include: data storage and manipulation, control structures, functions and sub-programming. Introduction to object-oriented programming. Students cannot receive credit for both CSE 130 and EGR 141. Offered fall, winter. (Cross-listed with CIT 130). *Satisfies the university general education requirement in the formal reasoning knowledge foundation area.*
Prerequisite: MTH 012 or equivalent.

CSE 142 Introduction to C Programming and Unix (2)
Introduction to programming and problem solving using C and Unix. The topics include fundamentals of C programming and basic Unix commands including file organization, user commands, and utilities in Unix and creating, editing, executing, and debugging C programs.
Prerequisite: CSE 110 and MTH 154 or equivalent.

CSE 220 Spreadsheet Programming and Reporting (4)
Introduction to business applications using Visual Basic. Emphasis is on structured programming for automating word processing and spreadsheet applications including creating reports using a report writer for database record sets from integrated business applications. Topics include Office Automation events, properties, methods, and programming techniques. *Satisfies the university general education requirement in the knowledge applications integration area. Prerequisite for knowledge applications: completion of the general education requirement in the formal reasoning knowledge foundation area.* (Crosslisted with CIT 220).
Prerequisite: CIT 130 or CSE 130 and MTH 122 or 154 or equivalent.

CSE 230 Object-Oriented Computing I (4)
Introduction to object-oriented computer programming using a high-level programming language such as Java. Classes, member functions, inheritance, polymorphism and operator overloading. Design methodologies and introduction to software engineering principles and practices. Basic data structures are introduced. (cross-listed with CIT 230).
Prerequisite: EGR 141 or CIT 130 or CSE 130 or 142 or equivalent.

CSE 231 Object-Oriented Computing II (4)
A second course in programming, with emphasis on data abstraction and object-oriented design. The basic data structures in computer science, including stacks, queues, lists and trees, are covered in detail. Concepts of design, analysis and verification are discussed in the context of abstract data types. Examples of applications taken from numeric and symbolic domains are used.
Prerequisite: CSE 230 or CIT 230.

CSE 232 C++ for Programmers (2)
A course in C++ programming for programmers with basic knowledge of data types and control structures in programming languages. Topics include pointers, memory management, classes, polymorphism, overloading, templates, input/output, parameter passing, multiple inheritance, standard template library, and philosophical differences in major object-oriented programming languages.
Prerequisite: CSE 230 or equivalent.

CSE 233 Immersive Python (2)
This course introduces the fundamentals and applications of Python. The language fundamentals covered are statements, variables, comments, control structures, functions, modules, packages, and objects. The course also includes advanced concepts such as collections (Lists, Tuples and Dictionaries) with their practical use for Data Processing, Systems administration, and Web development applications.
Prerequisite: CIT 130 or CSE 130 or CIT 230 or CSE 230.

CSE 234 Ruby for Web Developers (2)
This course introduces the dynamic programming language Ruby -- focusing on language fundamentals, debugging and external language binding techniques, and extremely popular web development framework Ruby on the Rail (ROR). The basic ROR topics include discussion of convention over configuration as used by ROR and RESTFul web development with practical exercises.
Prerequisite: CIT 130 or CSE 130 or CIT 230 or CSE 230.

CSE 235 Programming in Visual C# for .NET Technology (2)
This course covers C#.NET for programmers who already have the basic knowledge for object-oriented programming techniques. Topics include: Windows forms, Common Language Run Time (CLR), assemblies, ADO.NET, XML, Web Services, Mobile and Embedded Development.
Prerequisite: CIT 230 or CSE 230.

CSE 236 Embedded C Language (2)
Introduces concepts of C language programming for embedded system applications. Provides rigorous treatment of theory and embedded program practice. Topics covered include: Syntax, fixed and floating point arithmetic, flow control, functions, arrays, pointers, characters, strings, input/output, bit manipulation, data structure, preprocessor (define, pragma, etc.), Embedded C standards, DSP extensions for C.
Prerequisite: EGR 141 or CIT 230 or CSE 230.

CSE 247 Introduction to Computer Networks (4)
An introduction to fundamental concepts for design and analysis of computer networks. Topics covered include the Internet, network protocols, Local Area Networks (LAN), wireless and mobile networks, network security, and socket programming.
Prerequisite: high level programming course or CIT 230 or CSE 230.

CSE 252 Interactive Web Systems (4)
This course introduces the fundamentals of interactive multimedia in context of web technologies. Topics covered include use of modern web development tools, Markup Languages, server-side processing, and client-side processing using languages such as JavaScript. Students will use these tools to create interactive and dynamic web sites. (Crosslisted with CIT 252). *Satisfies the university general education requirement in the knowledge applications integration area. Prerequisite for knowledge applications: completion of the general education requirement in the formal reasoning knowledge foundation area.*
Prerequisite: CIT 122 or CIT 130 or CSE 130.

CSE 280 Sophomore Project (2)
A team-oriented project work consisting of a small project to build skills in needs assessment, group problem solving, and written and oral technical presentations. Prerequisite: CSE 230 or CIT 230.

CSE 335 Programming Languages (4)
Fundamental concepts in programming languages. Several high-level languages are studied in depth and their approaches to the fundamental issues in language design are compared. Issues include: data types and structures, control structures, binding times, run-time, storage organization, flexibility vs. efficiency, compiled vs. interpreted languages, strong vs. weak typing, block structure and scope of names. Offered fall.
Prerequisite: CSE 231, MTH 275 and major standing.

CSE 337 Software Engineering and Practice (4)
Introduction to software engineering and practice. Topics include software process models, project management, requirements analysis, software quality assurance, and testing. Crosslisted with CIT 337.
Prerequisite: Major standing.

CSE 343 Theory of Computation (4)
Formal models of computation, including finite state automata, pushdown automata and Turing machines. Regular and context-free languages. The computational models are used to discuss computability issues. Offered winter.
Prerequisite: CSE 361 and major standing in CS.

CSE 345 Database Design and Implementation (4)
Introduction to the design and implementation of database systems. Topics include designing a practical database for an application using normal forms, understanding relational database schemas, planning and implementing a database using software such as Oracle and Microsoft SQL Server, advanced database topics in redundancy, replication, load balancing, compatibility, ODBC and JDBC, and database systems administration. (Cross-listed with CIT 345).
Prerequisite: Major standing.

CSE 361 Design and Analysis of Algorithms (4)
Computer algorithms, their design and analysis. Strategies constructing algorithmic solutions, including divide-and- conquer, dynamic programming and greedy algorithms. Development of algorithms for parallel and distributed architectures. Computational complexity as it pertains to time and space is used to evaluate the algorithms. A general overview of complexity classes is given. Offered fall and winter.
Prerequisite: CSE 231, APM 263, and major standing in CS.

CSE 364 Computer Organization (4)
Assembly language, addressing modes, RISC and CISC architectures, assemblers, loaders, linkers arithmetic and logic unit, hardware functional units, input/output organization, memory organization, cache memory, virtual memory, control unit, pipelining, parallel computer organization.
Prerequisite: EGR 240 and major standing in CS.

CSE 378 Computer Hardware Design (4)
Development of components and techniques needed to design basic digital circuits and systems for computers, communication and related applications. Design and analysis of combinational and sequential logic circuits using a hardware description language such as VHDL. Design of a small digital computer and its implementation in an FPGA. Prerequisite: EGR 240 and major standing in CS.

CSE 402 Professional Practice (2)
Seminars on software piracy, hacking, privacy, professional conduct, and the impact of information technology on society.
Prerequisite: major standing.

CSE 450 Operating Systems (4)
Introduction to the concepts and design of multi-programmed operating systems. Typical topics include: historical perspectives, sequential processes, concurrent processes, processor management, memory management, scheduling, file management, resource protection, a case study. Offered fall, winter.
Prerequisite: CSE 361 and CSE 364 and major standing in CS.

CSE 461 Bioinformatics (4)
This course covers the fundamental algorithms and computational methods for study of biological sequence data for comparative biology and evolution with the focus on discovery of genome content, function and organization. Specific methodologies covered include the algorithms for searching sequence databases, pair-wise and multiple sequence alignment, phylogenetic methods, and methods for pattern recognition and functional inference from sequence data.
Prerequisite: major standing.

CSE 470 Microprocessor-based Systems Design (4)
Application of microprocessors and microcomputers to the solution of typical problems; interfacing microprocessors with external system such as sensors, displays and keyboards; programming considerations, microcomputer system and memory system design. A laboratory, design course; several short design projects and one large design project. Written report and oral presentation required. Credit cannot be earned for both CSE 470 and ECE 470. Offered fall, winter.
Prerequisite: CSE 378 and major standing.

CSE 480 Senior Capstone Project (4)
A team-oriented senior design course for computer science and computer engineering majors. Teams will conceive, analyze, design, implement and test a computer-based hardware and/or software system, component or process. Results will be demonstrated and documented in oral presentations and written reports. *Satisfies the university general education requirement for the capstone experience. Satisfies the university general education requirement for a writing intensive course in the major. Prerequisite for writing intensive: completion of the university writing foundation requirement.*
Prerequisite: CSE 364 and 337 or 345, major standing and senior standing.

CSE 490 Senior Project (2 to 4)
Independent work on advanced laboratory projects. Topic must be approved prior to registration. May be taken more than once.
Prerequisite: major standing.

CSE 494 Independent Study (2 to 4)
Advanced individual study in a special area. Topic must be approved prior to registration. May be taken more than once.
Prerequisite: major standing.

CSE 495 Special Topics (2 to 4)
Advanced study of special topics. May be taken more than once.
Prerequisite: major standing.

The 500 level CSE courses are graduate level courses. These are open to undergraduate students with instructor permission and major standing.

CSE 522 Objective Oriented Analysis and Design (4)
This course covers the methodologies of object oriented (OO) modeling during the planning, analysis and design stages of software systems development. Predominate methodologies and techniques such as the Unified Modeling Language (UML) will be surveyed. OO programming using an OO language such as C++ or Java is not covered in this course. Topics include both process oriented issues, such as the application of use case modeling during OO requirements analysis, and product-oriented issues, such as the definition of an OO design using class diagrams.
Prerequisite: CSE 337, 505, 506 and 507 or equivalent.

CSE 538 Software Verification and Testing (4)
The course consists of three main parts: Formal Verification (proofs of correctness), Static Program Analysis (detection of program anomalies, explanatory analysis, static debugging) and Dynamic Program Analysis (testing and debugging), the latter two representing software engineering approach to software verification. Most of the course consists of lectures by the instructor and discussions of the assignments. If the size of the class is relatively small, a seminar could be required in lieu of an assignment. Two software tools are used: SPARK (Static Analysis, Verification), and STAD, System for Testing and Debugging, for static analysis and testing.
Prerequisite: CSE 337 or equivalent.

CSE 542 Rapid Proto and Component Software (4)
Methodologies for rapid prototyping and component software use. Topics include: platforms for rapid prototyping and object-oriented software development, available software components, object request brokers (COM/CORBA/OLE), data modeling, transaction processing and federated database, client and server web technologies. A theory and project-oriented course.

CSE 549 Wireless and Industrial Networks (4)
Wireless networking topics covered include wireless computer network protocols (802.11, WiMax), wireless personal area network protocols (Bluetooth, ZigBee), wireless sensor networks and cellular networks. Industrial and embedded networking topics covered include Controller Area Network (CAN), Modbus, Profibus, Foundation Fieldbus and Industrial Ethernet. Networking applications are designed and implemented as student projects. Recommended prerequisite: MTH 275 and STA 226 or equivalent.

CSE 555 Visual Computing (4)
Visual computing is the confluence of computer vision, image processing and analysis, computer graphics, and visual information management. This course covers fundamentals of visual computing with emphasis on image processing, image analysis and graphics rendering. The topics to be covered include: image filtering, image compression, image segmentation, image morphing, 2D/3D primitives, 2D/3D geometry transformation, 2D/3D rasterization, illumination and animation.
Prerequisite: MTH 256, CSE 507 or equivalent.

CSE 581 Information Retrieval and Knowledge Discovery (4)
This course covers the models for information retrieval from text and multimedia databases. Methodologies for database indexing and visualization are discussed. Statistical and deterministic algorithms for discovering knowledge from databases, including, decision trees, clustering, regression, and neural models are covered.
Prerequisite: CSE 545 or equivalent.

CSE 583 E-Commerce and ERP (4)
This course focuses on the evolving technologies on the world wide web that support new models of business. These models include 1) electronic commerce with concerns of fault tolerance, security, and 24x7 availability and 2) ERP with concerns of financial, human resource and manufacturing systems integrating together into inter-company supply chain systems.

ELECTRICAL AND COMPUTER ENGINEERING

ECE 276 Circuits and Systems (4)
Sinusoidal steady-state analysis, Laplace transform methods, transfer functions and systems concepts. Relationships between pole-zero pattern and dynamic response. Circuits with dependent sources; Mesh and Nodal analysis. Analysis of mechanical and electro-mechanical systems. Analogous systems. Complete response of first and second order circuits and systems. Use of PSpice and Matlab. With Laboratory. Offered fall and winter.
Prerequisite: APM 255 and EGR 240.

ECE 327 Electronic Circuits and Devices (4)
Characteristics and models of nonlinear circuit elements, such as diodes, BJTs and MOSFETs. Analysis and design of circuits employing these devices, including power supplies, voltage regulators, and amplifiers; Biasing and circuit stability issues. Use of Operational amplifiers, discrete circuit elements; and PSPICE software for circuit design is emphasized in the lab. Offered fall, winter.
Prerequisite: ECE 276.

ECE 335 Signals and Systems (3)
Introduction to signals and systems; convolution, correlation, and their applications. Frequency domain analysis using Fourier series and Fourier transform techniques. Frequency response, Bode plots, bandwidth, energy and power spectral density. Analysis of filters and applications, transformation between LP, HP, BP & BS filters. State-space model, Eigen value analysis, similarity transformation, applications. Offered fall, winter.

ECE 345 Electromagnetics I (3)
This course provides students with an understanding of Maxwell's equations with emphasis on the properties of materials, electrostatics, magnetostatics and theory and application of transmission lines. A thorough review of waves, phasors and vector calculus is also provided to lay the mathematical foundation to cover the topics in this course.
Prerequisite: ECE 276 and MTH 254 and major standing.

ECE 351 Electromechanical Energy Conversion I (3)
Magnetic circuits, transformers, magnetic energy and force/torque, and necessary condition of electromechanical energy conversion. DC and AC machines and their equivalent circuits, input/output characteristics, torque analysis and power efficiency. Introduction to DC motor drives and position/speed control systems.
Prerequisite: ECE 276 and major standing.

ECE 352 Electromagnetics and Electromechanism (4)
Fundamentals of electromagnetic fields, waves and Maxwell's equations. Magnetic circuits and single/poly-phase transformers. Electromagnetic and electromechanical devices. DC motors, drives and position/speed control circuits. Basic characteristic analysis of AC motors and generators. With laboratories. Offered winter.
Prerequisite: ECE 276, MTH 254 and major standing.

ECE 378 Digital Logic and Microprocessor Design (4)
Development of components and techniques needed to design basic digital circuits and systems for controllers, computers, communication and related applications. Design and analysis of combinational

and sequential logic circuits using a hardware description language such as VHDL. Design of dedicated microprocessors and their implementation in an FPGA. With laboratories. Offered fall, winter, summer.
Prerequisite: EGR 240 and major standing.

ECE 384 Electronic Materials and Devices (3)
Semiconductor materials and device physics; charge carriers and conduction mechanisms, Energy Band Diagram. Theory of metal-semiconductor contacts and junction diodes. Unipolar and bipolar devices: MOSFETs threshold voltage, characteristics, circuit models and regions of operations; Bipolar junction transistors, and introduction to CMOS with integrated circuit technology, layout and simulation. Offered fall and winter.
Prerequisite: major standing.

ECE 423 Robotic Systems and Control (4)
Introduction to robotic systems and applications. Robotic forward and inverse kinematics. Task and path planning with motion controls. Jacobian matrix, differential motion and robotic statics. Redundant robots, mobile robots and multi-robot coordination. Robotic dynamics, position control and force control. Computer simulation and laboratory demonstration. Offered fall or winter.
Prerequisite: ECE 335 and major standing.

ECE 426 Advanced Electronic Circuit Designs (4)
Design and analysis of analog circuits. Analysis and design of differential amplifiers. Design of signal generators and function generators. Introduction to measurement sensors and interfacing. Introduction to sensors including bio-medical and micro-electromechanical (MEMS) based measurement circuits and systems. Emphasis on analysis and design through a sequence of laboratory experiments and short projects. Offered winter.
Prerequisite: ECE 327 and major standing.

ECE 428 Industrial Electronics (4)
Applications of advanced electronics to manufacturing processes. Analysis and design considerations for industrial electronic systems. Operation of programmable controllers. Modeling and characteristics of integrated process elements. Transducers, signal conditioning and transmission; analog and digital controllers; thyristor commutation techniques; power supplies and interfaces, DC and AC drives and motor control circuits. With laboratory and design projects.
Prerequisite: ECE 327 and major standing.

ECE 429 Introduction to Power Electronics (4)
Power semiconductor devices and circuits. AC/DC Converters. Thyristors and commutation techniques. Phase-controlled rectifiers, choppers and inverters. AC voltage controllers and cycloconverters. Introduction to novel power electronic devices, such as IGBT and power MOSFET. Some industrial applications. With laboratory.
Prerequisite: ECE 327 and major standing.

ECE 431 Automatic Control Systems (4)
Mathematical modeling of dynamic systems, transfer functions, state-space representation, time domain transient and steady-state response analyses; stability theory and stability criteria; root-locus analysis and design; frequency-response analysis and designs; design of proportional, integral and derivative controllers, compensation networks. Use of Matlab and Simulink.
Prerequisite: ECE 276, ECE 335 and major standing.

ECE 433 Control System Design (4)
Design methodology for control systems via state space approach; modeling and transformation. Physical systems, time response, stability, transition matrix, state feedback control. Integrated system design, state observers. Analytical and computer simulations. Course includes a project to model, design,

implement and evaluate a controller for a practical system. Offered fall.
Prerequisite: ECE 431 and major standing.

ECE 437 Communication Systems (4)
Basic modules in communications systems and their functions; signal characteristics: bandwidth, power and energy; filtering; functions of the basic modules, filters, mixers, modulators, demodulators, PLL; amplitude modulation; frequency modulation; sampling and quantization. Offered fall and winter.
Prerequisite: ECE 335 and ECE 327 and major standing.

ECE 441 Electromechanical Energy Conversion II (4)
Advanced study of electromagnetic systems. The principle of duality between magnetic and electric circuits. Necessary conditions for electromechanical energy conversion. Modeling, equivalent circuits and steady-state/transienty analyses of DC and AC electric machines. Speed control of DC and AC motors with industrial applications. With laboratories.
Prerequisite: ECE 351 and major standing.

ECE 443 Electromagnetics II (4)
Discussion of electromagnetic fields. Application of field theory to solution of problems from various branches of electrical engineering. Included are relation of field theory to circuit theory, Poynting's theorem, stored energy and power flow, complex fields and power, transverse electromagnetic waves, uniform plane waves and wave reflection/refraction at normal incidence.
Prerequisite: ECE 345 and major standing.

ECE 447 Antennas (4)
Introduction to antenna performance parameters including field patterns, power patterns, beam area, directivity, gain, beam efficiency, radiation intensity, antenna apertures, impedance, polarization, and the radio communication link. Dyadic Green's Function, radiation from current elements such as a dipole and a current loop, far-zone fields, arrays of point sources. Antenna modeling and measurement techniques will be introduced. Course will incorporate labs and/or laboratory demonstrations.
Prerequisite: ECE 345 and major standing.

ECE 450 Satellite-based Positioning System (4)
Introduction to satellite-based positioning systems with emphasis on Global Positioning System (GPS). GPS satellite constellation, coordinate systems, timing standards, GPS signal structure. Determination of position from range measurements. Ranging error sources and mitigation techniques. Impact of ranging errors and satellite geometry on 3-dimensional position error. Offered fall.
Prerequisite: ECE 335 and major standing.

ECE 458 Electrical Energy Systems (4)
Generation, transmission and distribution of electrical energy. Analysis and design of three-phase circuits, representation of power systems and per unit normalization, symmetrical components and stability, unsymmetrical faults. Computer-aided problem solving included. Offered winter.
Prerequisite: ECE 335 and major standing.

ECE 463 Foundations of Computer-Aided Design (4)
Computer-aided design as the cornerstone of computer-aided manufacturing. Presentation and exploration of "generic" CAD architecture. Mathematical representations of CAD primitives, surfaces and solids and manipulation. Comparison of wire-frame, surface, 2-1/2 D and solid models. Covers IGES, STEP, CALS, DXF standards. Description of "feature based CAD" and the CAD manufacturing link.
Prerequisite: major standing.

ECE 469 Computer Simulation in Engineering (4)
Simulation as modeling tool for discrete-event and continuous systems, general principles of simulation, statistical models, input modeling, random variable generation, model building using a commercial simulation language, model verification and validation, determination of run length, output analysis, variance reduction techniques. Design and optimization of production service systems. Offered winter.
Prerequisite: major standing and ECE 335.

ECE 470 Microprocessors-based Systems Design (4)
Application of microprocessors and microcomputers to the solution of typical problems; interfacing microprocessors with external systems such as sensors, displays and keyboards; programming considerations, microcomputer system and memory system design. A laboratory, design course; several short design projects and one large design project. Written report and oral presentation required. Credit cannot be earned for both CSE 470 and ECE 470. Offered fall, winter.
Prerequisite: ECE 378 and major standing.

ECE 472 Microcomputer-based Control Systems (4)
Computer-aided engineering, analysis, design, evaluation of control systems. Microcomputer/microprocessor-based hardware and software development of digital controllers, estimators, filters. Data acquisition, signal conditioning and processing circuits, graphics displays. On-line system level and board-level microcomputer-based control experiments. Laboratory and projects emphasize real-time applications, programming and hardware integration. With laboratory. Offered winter.
Prerequisite: ECE 327 or ECE 473, and ECE 431 and major standing.

ECE 473 Automotive Electronics (4)
Review of basic automotive electronic devices and circuits. Characteristics, models and interfacing of sensors and actuators. Basic electronic and electromechanical controllers; engines, transmission, brake, suspension and traction. Battery system supply. Ancillary system components: safety, auto theft, diagnostics, collision. With laboratory. (Not for credit for electrical engineering majors).
Prerequisite: major standing.

ECE 475 Automotive Mechatronics I (4)
Overview of mechatronics; modeling, simulation, characterization and model validation of electromechanical devices; introduction to computer-aided software; basic automotive sensors; basic actuators and power train devices; principles of automotive and industrial electronic circuits and control systems (analog and digital); principles of product design; mechatronics case studies. With laboratory.
Prerequisite: ECE 276, 335 and major standing.

ECE 485 VLSIC Design of Digital Chips (4)
CMOS Very Large Scale Integrated Circuits design methodology for rapid implementation and evaluation. From digital systems level to circuit, device, and processing layout. Combinational and sequential circuit characterization and performance estimation. Inverters, logic, and transmission gates switching characteristics. Reliability and yield. Application Specific ICs design projects using professional CAD tool-suites. With laboratory. Offered winter.
Prerequisite: ECE 384 and major standing.

ECE 487 Integrated Electronics (4)
Modern microelectronics processes and fabrication of integrated circuits. Crystal growth, wafer preparation, photolithography, dielectric and polysilicon film deposition, epitaxial growth, oxidation, diffusion, ion implantation, etching, metallization and integrated circuits layout principles. Introduction to MOS-based and bipolar transistor-based microcircuits design and fabrication. Fabrication processing simulation using SUPREM. With laboratory and projects.
Prerequisite: ECE 384 and major standing.

ECE 490 Senior Project (2 to 4)
Independent work on advanced laboratory projects. Topic must be approved prior to registration. May be taken more than once.
Prerequisite: major standing.

ECE 491 Senior Design (4)
Capstone design projects selected from a wide variety of areas related to electrical and computer engineering. Develops system approach to design: preparation of specifications, scheduling, modeling, simulations, and technological, financial and environmental aspects. Multi-discipilinary teamwork is emphasized. Prototyping, testing and completion of the project are required. Presentation of results required. *Satisfies the university general education requirement for a capstone experience. Satisfies the university general education requirement for a writing intensive course in the major. Prerequisite for writing intensive: completion of the university writing foundation requirement.*
Prerequisite for Electrical Engineering majors: ECE 327, 345, 351 and ECE 378.
Prerequisite for Computer Engineering majors: ECE 327, 378 and 470.
Corequisite for Electrical Engineering majors: ECE 431, 437.

ECE 494 Independent Study (2 to 4)
Advanced individual study in a special area. Topic must be approved prior to registration. May be taken more than once.
Prerequisite: major standing.

ECE 495 Special Topics (2 to 4)
Advanced study of special topics in engineering. May be taken more than once.
Prerequisite: major standing.

The following courses are graduate level courses open to undergraduate students with instructor permission and major standing:

ECE 520 Signal and Linear Systems Analysis (4)
Modeling and analysis of both continuous-time and discrete-time systems and signals. Time domain and frequency-domain representation methods and transformations applied to electric circuits, mechanical systems and other dynamic systems. Fundamental theories of systems stability, controllability, observability and state-feedback control design. Computer simulation studies. Offered fall.

ECE 525 Instrumentation and Measurements (4)
Errors in measurements, error corrections and minimization; transducers and their applications; signal conditioning and interfacing; electromagnetic compatibility and interference problems in instrumentation; measurement instruments and their characteristics. Measurement systems, signal analyzers and data acquisition systems; signal conversion; computer and microprocessor-based instrumentation. With project. (Previously EE 525). Offered fall.

ECE 527 High-Frequency Electronics (4)
Transmission lines with sinusoidal and pulse excitation. Passive and active circuit components at high frequency. High frequency amplifiers, communication circuits, waveform generators and digital circuits. Introduction to high frequency measurements. (Previously EE 726.)

ECE 533 Random Signals and Processes (4)
Provides the foundation needed to work with the random signals which are encountered in engineering. Concept of a random variable. Properties of one- and multi-dimensional random variables. Concept of a stochastic process. Characterization of random waveforms using power spectral density and the correlation function. Random signals in linear systems. Applications to engineering systems. Offered winter.

ECE 534 Principles of Digital Communications (4)
Source coding, signal design, modulation and demodulation. The optimal receiver principle, synchronization, communications over narrow band channels, fading channels and error correction codes. Offered fall.
Prerequisite: a previous course in communications systems.

ECE 537 Digital Signal Processing (4)
Analysis of discrete signals and systems. Introduction to digital filters including finite and infinite impulse response filter. Discrete and Fast Fourier Transformations. Application of digital signal processing. Offered Winter.
Prerequisite: basic knowledge of linear systems.

ECE 557 Energy Conservation Systems (4)
Techniques for improving energy use in industrial and commercial applications. Topics include: energy accounting; energy auditing; energy conservation management; net energy analysis; second law methods of analysis; combined use energy systems; new technology for energy conservation; assessment of alternative technology. Credit can not be received for both ECE 557 and ISE 557.

ECE 567 Computer Networks (4)
Resource-sharing principles; communications and networks; packet switching; the ARPANET; network performance using principles of queuing theory; network design principles, capacity assignment; flow assignment; topological design. Other related topics.

ECE 581 Integrated Circuits and Devices (4)
Fundamentals of semiconductor electronics. Theory and operation of PN junctions and junction devices. MOS devices. Integrated circuits functional blocks, fabrication techniques, processing steps and equivalent circuits. Device modeling and simulation techniques. Offered Fall.

The following courses are graduate level courses open to undergraduate students with instructor permission:

SYSTEMS ENGINEERING

SYS 510 Systems Optimization and Design (4)
Classical optimization techniques including Lagrange multipliers and Kuhn-Tucker conditions. Computer techniques for system optimization including linear programming, constrained and unconstrained nonlinear programming. Introduction to global optimization, genetic algorithm, and dynamic programming. The course emphasizes a design experience involving system modeling, simulation and optimal design. Offered Summer.

SYS 517 Probability/Manufacturing Applications (4)
Techniques and topics from probability of use to engineers, particularly those interested in manufacturing. Includes topics from statistics, control charts, propagation of error and tolerancing, analysis of queuing systems using birth and death processes and Markov chains, reliability, decision trees, etc. Credits cannot be received for both SYS 517 and ISE 517. Offered winter, odd years. Student must have completed a course in probability.

INDUSTRIAL AND SYSTEMS ENGINEERING

ISE 150 How Things Work (4)
For non-science majors, a practical introduction to engineering and science in everyday life. This course considers objects from our daily environment and focuses on their principles of operation, histories and

relationships to one another. ISE 150 emphasizes concepts from mechanical and thermal objects. *Satisfies the university general education requirement in the knowledge applications integration area.*
Prerequisite: completion of the general education requirement in the writing foundation area.

ISE 310 Engineering a Great Life (4)
The principles of Systems Engineering will be taught and applied to the various aspects of a person's life. The principles revolve around a purpose-driven life cycle for achieving measurable goals including needs assessment, design, implementation, evaluation, fielding, maintenance, and recycling. The areas of life examined include maintenance of the self, relationships with others, business success and worldwide issues. Students will be expected to demonstrate measurable change in their own life using the principles of the course. *Satisfies the university general education requirement in the knowledge application integration area and for the capstone experience. Prerequisites for knowledge application: completion of the general education requirement in the formal reasoning knowledge foundation; social science and natural science and technology knowledge exploration areas.*

ISE 318 Engineering Statistics and Economic Analysis (4)
Simple linear and multiple linear regression analysis, design of experiments – single factor, full factorial, fractional factorial design. Taguchi's method, control charts, and time series analysis. Engineering cost models, equivalence analysis, estimation of net present value, rate of return, depreciation and taxes, incremental analysis, and uncertainty in cash flow. Offered fall.
Prerequisite: EGR 260 and major standing.

ISE 330 Engineering Operations Research (4)
Introduction to operations research models used in decision making and system performance evaluation. Topics include linear programming including simplex method and duality theory, integer linear programming, the assignment and transportation problems, network flows and dynamic programming. Offered winter.
Prerequisite: major standing.

ISE 341 Work Methods and Ergonomics (4)
Design, analysis, and measurement of work: work/time studies, pre-determined time studies, and line/work balancing techniques for both repetitive and non-repetitive work. Anthropometry and techniques for consideration of anthropometric data in the design and analysis of work. Offered fall. With laboratory.
Prerequisite: major standing.

ISE 422 Robotic Systems (4)
Overview of industrial robotic manipulators, their components and typical applications. Kinematics of robots and solution of kinematic equations. Trajectory planning and the Jacobian matrix. Robot programming languages and task planning. Laboratory experience in the development and implementation of a kinematic robot controller using a reconfigurable industrial manipulator. Demonstrations and applications using industrial robots. With laboratory. Credit cannot be received for both ISE 422 and ME 478. Offered fall.
Prerequisite: major standing.

ISE 430 Engineering Operations Research – Stochastic Models (4)
Review of linear programming, duality theory, integer programming, and nonlinear programming. Topics include stochastic dynamic programming, ergodic and absorbing Markov chains with applications, and queuing models with applications based on birth-death process. Introduction to stochastic inventory models and Markov decision processes with applications. Offered fall.
Prerequisite: ISE 330 and major standing.

ISE 441 Human Factors (4)
Human body's physical capabilities impacting work design and productivity; its functional capabilities: joint stresses; fatigue analysis. Biomechanical principles applied to design and analysis of work: posture

analysis, lifting aids; risk assessment. Work related infractions: repetitive injury; non-repetitive injury. Human body's sensory and cognitive limitations in the work environment. Offered winter.
Prerequisite: ISE 341 and major standing.

ISE 464 Design for Manufacturing and Assembly Analysis (4)
Role of a geometric modeler in design and manufacturing. Representation of wire-frame, surface, solid models and feature-based models. Different standards for representation of geometric data. Analysis of a design for DF(x) principles that include manufacturing, assembly, disassembly and environment. With laboratory.
Prerequisite: major standing.

ISE 469 Computer Simulation of Discrete Event Systems (4)
Simulation as modeling tool for discrete-event systems, general principles of simulation, statistical models, input modeling, random variable generation, model building using a commercial simulation language, model verification and validation, determination of run length, output analysis variance reduction techniques. Design and optimization of production service systems. With laboratory. Offered winter.
Prerequisite: ISE 318 and major standing.

ISE 480 E-Commerce and ERP (4)
This course focuses on the evolving technologies on the world wide web that support new models of business including 1) electronic commerce with concerns of fault tolerance, security, and 24x7 availability and 2) ERP with concerns of financial, human resource and manufacturing systems integrating into inter-company supply chain systems. Offered fall. Prerequisite: major standing.

ISE 483 Production Systems and Workflow Analysis (4)
Design issues to control the flow of material in manufacturing systems from forecast to finished product. Topics include aggregate planning and disaggregation, inventory control, MRP, JIT systems, scheduling, project planning and resource balancing, application of lean principles, theory of constraints and supply chain, facilities planning and layout. Offered fall.
Prerequisite: ISE 330 and major standing.

ISE 484 Flexible and Lean Manufacturing Systems (4)
Technologies and concepts that make manufacturing systems flexible: CAM, Group Technology (GT), Computer Numerically Controlled (CNC) machining centers, robotics, automated warehousing (AS/RS), vision systems, material transport, Programmable Logic Controllers (PLC). Introduction to lean manufacturing. With laboratory. Credit cannot be received for both ISE 484 and ME 473. Offered winter.
Prerequisite: major standing.

ISE 485 Statistical Quality Analysis (4)
Fundamentals of statistical quality control, control charts for variable and attribute data, custom charts, DNOM charts, estimation of process capability, statistical tolerancing and sampling plans. Fundamentals of design of experiments and application to product/process design. Taguchi's approach to robust design and related topics. Formerly SYS 485. Offered winter.
Prerequisite: ISE 318 and major standing.

ISE 487 Foundations of Systems Engineering (4)
Techniques for generation, analysis and verification of traceable product requirements. System performance and structural modeling using object, behavioral and other models. Techniques for analysis of system for serviceability, reliability, maintainability and testability. System alternative trade-off study techniques. System life cycle and other tools for implementation of systems engineering techniques. Offered winter.
Prerequisite: major standing.

ISE 488 Foundations of Systems Engineering II (4)
Mathematical underpinnings and theory of "Systemic Requirements" including reli-ability, use-ability, diagnose-ability, repair-ability, service-ability, maintain-ability, and recycle-ability.
Prerequisite: ISE 487 and major standing.

ISE 490 Senior Project (2 to 4)
Independent work on advanced laboratory projects. Topic must be approved prior to registration. May be taken more than once.
Prerequisite: major standing.

ISE 491 Senior Design (4)
Capstone design project selected from manufacturing systems, automotive or industrial systems, instrumentation and measurement, and control systems. Develops system approach to design; preparation of specifications, scheduling, modeling, simulation, and technological, financial environmental aspects. Teamwork is emphasized. Offered fall and winter. *Satisfies the university general education requirement for the capstone experience. Satisfies the university general education requirement for a writing intensive course in the major. Prerequisite for writing intensive: completion of the university writing foundation requirement.*
Prerequisite: ISE 318, 330, 341 and major standing.
Corequisite: ISE 483, or 487.

ISE 494 Independent Study (2 to 4)
Advanced individual study in a special area. Topic must be approved prior to registration. May be taken more than once.
Prerequisite: major standing.

ISE 495 Special Topics (2 to 4)
Advanced study of special topics in engineering. May be taken more than once.
Prerequisite: major standing.

MECHANICAL ENGINEERING

ME 308 Computer-Aided Design (3)
Use of engineering software in design and analysis such as: GD&T, solid modeling of machine parts, projection views layout, parametric and knowledge-based design, assembly design, sheet and metal design, build of materials, structure design, introduction of finite element method, engineering optimization, space analysis and clash detection, mechanism and kinematics of assemblies, project management. Offered fall and winter.
Prerequisite and corequisite: ME 361 and major standing.

ME 322 Engineering Mechanics (4)
Statics and dynamics of particles and rigid bodies: analysis of trusses, frames, beams, centroids and moments of inertia; kinematics, Newton's Second Law, work and energy, linear and angular impulse and momentum. With laboratory.
Prerequisite: EGR 280 and major standing.

ME 331 Introduction to Fluid and Thermal Energy Transport (4)
The fundamentals of fluid mechanics and heat transfer, conservation and momentum principles viscous and inviscid flow, laminar and turbulent flow, introduction to viscous and thermal boundary layer theory, one-dimensional conduction heat transfer and characteristics and dimensionless correlations of convection heat transfer, applications to engineering problems. Laboratory emphasizes experimental design. Offered fall, winter.
Prerequisite: EGR 250; MTH 254. Prerequisite or corequisite: EGR 280. Major standing.

ME 361 Mechanics of Materials (4)
Introduction to the mechanics of deformable bodies: distribution of stress and strain in beams, shafts, columns, pressure vessels and other structural elements, factor of safety, yield and fracture criteria of materials with applications to design. With laboratory including two-dimensional truss and beam design on computer. Offered fall, winter.
Prerequisite: EGR 280. Prerequisite or corequisite: ME 372 and major standing.

ME 372 Properties of Materials (4)
The atomic, molecular and crystalline structure of solids, including a description of x-ray analysis, metallography and other methods of determining structure; correlation of structure with the electric, magnetic and mechanical properties of solids. With laboratory. Offered fall, winter.
Prerequisite: CHM 143 or 157, PHY 152 and major standing.

ME 421 Vibrations and Controls (4)
Linear free and forced response of one- and multiple-degree freedom systems. Equations of motion of discrete systems. Vibration isolation, rotating imbalance and vibration absorbers. Transfer function and state-space approaches to modeling dynamic systems. Time and frequency domain and analysis and design of control systems. Use of MATLAB. Offered fall.
Prerequisite: ME 322 and major standing.

ME 423 Acoustics and Noise Control (4)
Introduction to vibrations and waves; plane and spherical acoustic waves; sound generation, transmission and propagation; sound intensity and power; principles and definitions of noise control; sound and hearing; hearing conservation; community, building and industrial noise control; measurement of sound.
Prerequisite: ME 322 and major standing.

ME 438 Fluid Transport (4)
Continued study of the fundamentals of fluid mechanics and their applications, angular momentum principle; generalized study of turbo machines, potential flow of inviscid fluids, laminar and turbulent boundary layer theory, dimensional analysis and similitude, compressible flow. With laboratory emphasizing engineering design. Offered fall.
Prerequisite: ME 331 and major standing.

ME 443 Polymeric Materials (4)
Terminology and nomenclature for plastics. General topics dealing with plastics, such as structure, morphology, properties, etc. Focus on mechanical and physical properties and mechanical behavior of plastics. Technology related to plastics processing, testing, designing and recycling is introduced.
Prerequisite: ME 372 and major standing.

ME 445 Plastics Product Design (4)
Design of plastic/composite products based on strength, stiffness, creeping, impacting, chemical and environmental deterioration. Effects of processing on part quality and performance. Design of plastic parts for manufacturability. Prototyping plastic parts. Design of plastic parts for joining and assembly. Use of CAD/CAM/CAE software for structural analysis and design optimization.
Prerequisite: ME 443 and major standing.

ME 448 Thermal Energy Transport (4)
Continued study of properties and descriptions of conduction, convection and thermal radiation heat transfer; thermal boundary layer theory; forced and natural convection, heat transfer correlations. Thermodynamics of thermal radiation, radiation intensity, surface properties and energy exchange. Laboratory emphasizes experimental design and development of empirical relationships. Offered winter.
Prerequisite: ME 331 and major standing.

ME 454 Alternative Energy Systems (4)
The analysis and design of alternative energy conversion systems. Primary topics include biomass energy conversion, including biofuels, solar and wind power will be primary topics. Other topics include fuel cells, geothermal energy and hydroelectric power. Includes design project(s).
Prerequisite: ME 331.

ME 456 Energy Systems Analysis and Design (4)
The analysis and design of thermodynamic systems. Applications include thermodynamic cycles for power; thermodynamics of non-reacting mixtures including psychrometry; concepts of available energy and application to process/system optimization; the thermodynamics of reacting mixtures, including chemical equilibrium concepts, applied to combustion systems. Design project (and/or laboratory) required. Offered winter.
Prerequisite: EGR 250 and major standing.

ME 457 Internal Combustion Engines I (4)
Introduction to thermodynamics, fluid mechanics and performance of internal combustion engines including: introduction to engine types and their operation, engine design and operating parameters, ideal thermodynamic cycles, thermodynamics of actual working fluids and actual cycles, gas exchange processes, heat losses, performance, exhaust gas analysis and air pollution. With laboratory. Offered fall.
Prerequisite: ME 456, senior standing and major standing.

ME 461 Analysis and Design of Mechanical Structures (4)
Methods of advanced mechanics of materials applied to the design of mechanical structures. Topics include stress and strain analysis, force equilibrium, deformation compatibility, torsion of non-circular cross-sections, torsion of thick-walled tubes, shear centers, non-symmetric bending, curved and composite beam and thick-walled tubes, shear centers, non-symmetric binding, curved and composite beams, and thick-walled cylinders. Offered fall.
Prerequisite: ME 361 and major standing.

ME 467 Optical Measurement and Quality Inspection (4)
Topics include the state-of-the-art optical methods such as holography, shearography, moire, three dimensional computer vision, electronic speckle pattern interferometry and laser triangulation; with applications to measurement of displacement, vibrational mode shapes, material properties, residual stresses, three-dimensional shapes, quality inspection and nondestructive testing. Offered fall and winter.
Prerequisite: ME 361, and senior standing and major standing.

ME 472 Materials Properties and Processes (4)
Study of mechanical behavior of real engineering materials and how they influence mechanical design. True stress/strain properties of materials, plastic deformation and fracture of materials, failure theories, fatigue damage under cyclic loading, creep and high temperature applications. Material properties of engineering metals, ceramics and composites. Behavior of materials during and after manufacturing processes such as stamping, drawing, extrusion, etc. Offered winter and summer.
Prerequisite: ME 361, ME 372 and major standing.

ME 473 Flexible Manufacturing Systems (4)
The components of flexible manufacturing systems (FMS): CNC machining centers; automated assembly; automated warehousing (AS/RS); inspection; material transport; programmable logic controllers and coordination; integration of CAD/CAM to the FMS; production planning and control; factory simulation; implementation strategies. With laboratory. Offered winter.
Prerequisite: major standing.

ME 474 Manufacturing Processes (4)
Fundamentals and technology of machining, forming, casting and welding. Mechanics of cutting. Molding of polymers. Tolerancing and surface topography. Manufacturing considerations in design.

Economics of manufacturing. Process assembly and product engineering. Lab to be arranged. Offered fall and winter.
Prerequisite: senior standing and major standing.

ME 475 Lubrication, Friction, and Wear (4)
Study of fundamental wear mechanisms including: adhesive, abrasive, corrosive and surface fatigue; boundary and hydrodynamic lubrication; friction theories; surface topography characterization. Applications: journal and ball bearings, gears and engine components. Offered fall and summer.
Prerequisite: ME 372 and senior standing and major standing.

ME 476 Product and Process Development (4)
Topics include traditional and nontraditional approaches in product and process development and optimization, including conventional experimental mechanics and acoustic test methods. The Taguchi approach and other methods for design of experiments are used to study the interaction of variables and to attain optimization.
Prerequisite: EGR 260 and major standing. Prerequisite or corequisite: ME 486 or ME 487.

ME 478 Robotic Systems (4)
Overview of industrial robotic manipulators, their components and typical applications. Kinematics of robots and solution of kinematic equations. Trajectory planning and the Jacobian matrix. Robot programming languages and task planning. Laboratory experience in the development and implementation of a kinematic controller using a reconfigurable industrial manipulator. Demonstrations and application using industrial robots. Offered fall.
Prerequisite: EGR 280 and major standing.

ME 482 Fluid and Thermal Systems Design (4)
Study of systems involving fluid and thermal phenomena such as energy conversion, and fluid and thermal energy support. Using fundamentals studied in prerequisite courses, component and system analyses, for purpose of design optimization, are emphasized using integral, differential and lumped-parameter modeling techniques. The course focuses on the design process using design-oriented laboratory projects.
Prerequisite: ME 331 and major standing.

ME 484 Vehicle Dynamics (4)
Vehicle dynamics analyses including: governing equation of motion, road loads, gradeability, aerodynamic forces and moments, longitudinal acceleration and braking performance prediction, lateral handling characteristics, vertical comfortability criteria, vehicle ride evaluation, and operating fuel economy analysis.
Prerequisite: ME 322, senior standing.

ME 486 Mechanical Systems Design (4)
Study of systems involving mechanical elements. Includes safety, stress, strength, deflection, economic and social considerations, optimization criteria and strategies. Analysis and design of fasteners, springs, welds, bearings, power transmitting elements and complex structures subjected to static and/or dynamic loads. Includes major design project. Offered winter.
Prerequisite: ME 361 and major standing.

ME 487 Mechanical Computer-Aided Engineering (4)
Introduction to the use of state-of-the-art finite element technology in mechanical engineering analysis. Fundamentals of computer graphics, solid modeling, finite element modeling and interactive design. Analysis and evaluation of linear static and dynamic mechanical systems. Includes design project(s) in various topics. Offered fall and summer.
Prerequisite: ME 322 and ME 361 and major standing.

ME 488 Mechanical Computer-Aided Manufacturing (4)
Use of CATIA in various aspects of manufacturing processes: GD&T and tolerance analysis, surface design, managing cloud points and reverse engineering, simulation of kinematics of machine tools, three-axis surface machining, mold tooling design, CMM and measurement data analysis, assembly simulation and structural analysis, rapid-prototyping. Includes design projects in various topics. Offered winter.
Prerequisite: ME 361 and major standing.

ME 489 Fasteners and Bolted Joints (4)
Systems approach to the analysis, and reliability of bolted joints under static and dynamic loads. Variables include the fastener, the joint, tool, control method, post assembly loads, relaxation and environmental factors. Laboratory experiments include torque tension, role of friction, ultrasonics, non-parallel contact, and elastic interactions. Offered winter.
Prerequisite: ME 486 and senior standing and major standing.

ME 490 Senior Project (3 or 4)
Work on advanced design and research projects. Topic must be approved prior to registration. If taken as an alternative to ME 492, student must work as part of a team of at least two people. May be taken more than once.
Prerequisite: ME 308, ME 331 and ME 361. Senior standing and major standing and approval of project proposal by ME Dept.

ME 492 Senior Mechanical Engineering Design Project (4)
Multi-disciplinary team experience in engineering design, emphasizing realistic constraints such as safety, economic factors, reliability, aesthetics, ethics and societal impact. Projects will be supervised by engineering faculty. Offered fall, winter. *Satisfies the university general education requirement for the capstone experience. Satisfies the university general education requirement for a writing intensive course in the major. Prerequisite for writing intensive: completion of the university writing foundation requirement.*
Prerequisite: ME 308, ME 331, ME 361 and major standing and senior standing.

ME 494 Independent Study (2 to 4)
Advanced individual study in a special area. Topic must be approved prior to registration. May be taken more than once.
Prerequisite: major standing and senior standing.

ME 495 Special Topics (2 to 4)
Advanced study of special topics in engineering. May be taken more than once.
Prerequisite: major standing and senior standing.