COMPUTER ENGINEERING MINOR

Computer Engineering Minor

A 19 to 21-credit Computer Engineering minor is a special and highly focused option for students majoring in Engineering and other related disciplines. The minor consists of the following course requirements:

[[EE-140]] - Scientific Programming or [[CS-125]] – Computer Science I
[[EE-247]] - Programming for Embedded Applications or [[CS-126]] – Computer Science II
[[EE-241]] – Digital Design
[[EE-345]] – Computer Organization
[[EE-342]] – Microcontroller Based System Design
One elective course from an Application Area (e.g., [[EE-314]] – Control Systems; [[CS-355]] – Computer Networks; or [[ME-317]] – Robotics)

CS. COMPUTER SCIENCE

CS-198, CS-298, CS-398. TOPICS IN COMPUTER SCIENCE
Credits: Variable

Study of one or more special topics in computer science. May be repeated for credit if different topics are emphasized. Offered when demand warrants.

Pre-Requisites
Varies with topic

CS-115. COMPUTERS AND APPLICATIONS
Credits: 3

An introduction to computers and computing, with emphasis on personal computing in both the Windows and OS X operating systems. Extensive hands-on experience will involve the application of current commercial software (including word processing, database, and spreadsheet). Not open to students who have received credit in any 200-level CS course. Students majoring in either Computer Science or Computer Information Systems will not receive credit for this course.

CS-125. COMPUTER SCIENCE I
Credits: 4

Introduction to information technology and programming (history of computing, text editors, word processing, spreadsheets, introduction to programming), basic data types, functions, decision structures, loops, one- and two-dimensional list structures, testing, debugging, and an introduction to computer graphics. Three hours of lecture and two hours of lab per week. Offered every fall and spring.
Click here for course fee.

Co-Requisites
[[MTH-100]] or higher

CS-126. COMPUTER SCIENCE II
Credits: 4

A study of advanced programming concepts, structures, and techniques (professional and ethical issues, testing and debugging, fundamentals of programming, basic data structures—strings, lists, multidimensional arrays, objects, hashes, inheritance, polymorphism, recursion, divide and conquer, machine representation of data, hardware components, machine instructions). Three hours of lecture and two hours of lab per week. Offered every fall and spring.
Click here for course fee.

Pre-Requisites
[[CS-125]] with grade of 2.0 or better OR equivalent programming experience.

CS-225. COMPUTER SCIENCE III
Credits: 3

A study of the use of a high-level language to implement basic data structures such as strings, lists, arrays, objects, and hashes, and their application to searching, sorting, and hashing. Representation of numbers and strings at the machine level. The course will also include an introduction to the concepts of algorithm design and problem solving with an emphasis on algorithm development, analysis, and refinement. Offered every fall.
Click here for course fee.

Pre-Requisites
[[CS-126]] with grade of 2.0 or better

CS-226. COMPUTER SCIENCE IV
Credits: 3

A continuation of [[CS-225]]. Topics include programming language paradigms, advanced use of word processors and spreadsheets, including macros, linked data structures, and an introduction to discrete mathematics, including counting, probability, and graphs. Offered every spring.
Click here for course fee.

Pre-Requisites
[[CS-225]] with grade of 2.0 or better

CS-246. C AND UNIX
Credits: 3

An introduction to using Unix operating systems, including shells, file manipulation, text editors, filters, and regular expressions. Fundamentals of C programming, including loops, arrays, functions, recursion, pointers, structures, unions, input/output, and system calls.
Click here for course fee.

Pre-Requisites
[[CS-125]] with grade of 2.0 or better

CS-265. MEDICAL INFORMATICS
Credits: 3

This course will cover basic principles of computer use and information management in health care (including general medicine, dentistry, optometry, and pharmacy). Topics will include basic computing concepts, the characteristics of medical data, and the use of computers in the administrative, diagnostic, and research oriented medical tasks. The course is primarily directed towards students who intend to pursue careers in health-related fields. Offered every spring.
Click here for course fee.

CS-283. WEB DEVELOPMENT I
Credits: 3

An introduction to the development of interactive web sites, including HTML, JavaScript, forms and CGI programs; server side includes cookies, web server configuration and maintenance. Offered in the fall semester of odd-numbered years when demand warrants.
Click here for course fee.

Pre-Requisites

[[CS-126]].

CS-285. MOBILE APPLICATIONS
Credits: 3

An introduction to programming mobile application development. Topics will include cross-platform development; user interface design; touchscreen, GPS, and motion sensing input; memory management; cloud services and network utilization; security and trust considerations; data privacy and ethics.

Click here for course fee.

Pre-Requisites

[[CS-126]] and [[CS-246]].

CS-317. SOFTWARE INTEGRATION
Credits: 3

An introduction to the integration of application programs, including email clients, word processors, spreadsheets, and database systems using Microsoft Office and Visual Basic.
Click here for course fee.

Pre-Requisites

[[CS-126]].

CS-319. PRINCIPLES OF PROGRAMMING LANGUAGES
Credits: 3

A study of the principles that govern the design and implementation of programming languages. Topics include language structure, data types, and control structures. Programming projects will familiarize students with features of programming languages through their implementation in interpreters.
Click here for course fee.

Pre-Requisites

[[CS-226]].

CS-321. SIMULATION AND DATA ANALYSIS
Credits: 3

Methods of handling large databases, including statistical analysis and computer simulations. The emphasis will be upon discrete simulation models with a discussion of relevant computer languages: ARENA, GPSS, and SIMSCRIPT.
Click here for course fee.

Pre-Requisites

[[CS-125]] and [[MTH-111]].

CS-323. THEORY OF COMPUTATION
Credits: 3

This course formalizes many topics encountered in previous computing courses. Topics include languages, grammars, finite automata, regular expressions and grammars, context-free languages, push-down automata, Turing machines, and computability.
Click here for course fee.

Pre-Requisites

[[CS-126]] and [[MTH-231]].

CS-324. SYSTEMS ANALYSIS
Credits: 3
Fees:

A study of the design and implementation of large computer projects. Special emphasis is placed on applications to business systems. Students will use a CASE tool for automated systems analysis and design.
Click here for course fee.

Pre-Requisites

[[CS-225]].

CS-325. DATABASE MANAGEMENT
Credits: 3
Terms Offered: Winter

Practical experience involving the fundamental concepts of database systems including data modeling; query languages; database management system implementation; management of semi-structured and multimedia data; distributed and noSQL databases
Click here for course fee.

Pre-Requisites

[[CS-126]].

CS-326. OPERATING SYSTEM PRINCIPLES
Credits: 3

Analysis of the computer operating systems, including Batch, Timesharing, and Realtime systems. Topics include sequential and concurrent processes, processor and storage management, resource protection, processor multiplexing, and handling of interrupts from peripheral devices.
Click here for course fee.

Pre-Requisites

[[CS-226]].

CS-327. COMPILER DESIGN
Credits: 3

A study of compiler design, including language definition, syntactic analysis, lexical analysis, storage allocation, error detection and recovery, code generation, and optimization problems.
Click here for course fee.

Pre-Requisites

[[CS-226]].

CS-328. ALGORITHMS
Credits: 3

Theoretical analysis of various algorithms. Topics are chosen from sorting, searching, selection, matrix multiplication of real numbers, and various combinatorial algorithms.
Click here for course fee.

Pre-Requisites

[[CS-226]] and [[MTH-232]].

CS-330. COMPUTER ARCHITECTURE
Credits: 3

A study of the design, organization, and structure of computers, ranging from the microprocessors to the latest 'supercomputers.' An emphasis will be placed on machine language, instruction formats, addressing modes, and machine representation of numbers.
Click here for course fee.

Pre-Requisites

[[CS-226]].

CS-334. SOFTWARE ENGINEERING
Credits: 3

A course in 'programming in the large.' Topics include software design, implementation, validation, maintenance, and documentation. There will be one or more team projects.
Click here for course fee.

Pre-Requisites

[[CS-226]].

CS-335. DATA SCIENCE AND INFORMATION RETRIEVAL
Credits: 3

Practical experience involving unstructured data collections. Topics cover big data, data mining, predictive modeling, decision analysis and indexing and retrieval including probabilistics, clustering, thesauri and passage based retrieval strategies.
Click here for course fee.

Pre-Requisites

[[CS-325]] or [[CS-340]]

CS-340. ARTIFICIAL INTELLIGENCE
Credits: 3

This course will provide an overview of artificial intelligence (AI) application areas and hands-on experience with some common AI computational tools. Topics include search, natural language processing, theorem proving, planning, machine learning, robotics, vision, knowledge-based systems (expert systems), and neural networks.
Click here for course fee.

Pre-Requisites

[[CS-126]].

CS-350. OBJECT-ORIENTED PROGRAMMING
Credits: 3

Object-oriented concepts and their application to human-computer interaction. Concepts to be covered include objects, classes, inheritance, polymorphism, design patterns, GUI interface guidelines, and design of interfaces. There will be programming projects in one or more object-oriented languages using one or more GUI interface guidelines.
Click here for course fee.

Pre-Requisites

[[CS-226]].

CS-355. COMPUTER NETWORKS
Credits: 3

This course introduces basic concepts, architecture, and widely used protocols of computer networks. Topics include the Open System Interconnection (OSI) model consisting of physical link layer, data layer, network layer, transport layer, session layer, presentation layer, and application layer, the medium access sublayer and LAN, various routing protocols, Transmission Control Protocol (TCP), and Internet Protocol (IP) for internetworking.
Click here for course fee.

Pre-Requisites

[[CS-225]] and [[CS-246]]

CS-363. OPERATIONS RESEARCH
Credits: 3

A survey of operations research topics such as decision analysis, inventory models, queuing models, dynamic programming, network models and linear programming. Cross-listed with [[MTH-363]].
Click here for course fee.

Pre-Requisites

[[CS-125]], and [[MTH-111]].

CS-364. NUMERICAL ANALYSIS
Credits: 3

An introduction to numerical algorithms as tools to providing solutions to common problems formulated in mathematics, science, and engineering. Focus is given to developing the basic understanding of the construction of numerical algorithms, their applicability, and their limitations. Cross-listed with [[MTH-364]]. Offered Spring odd years.

Pre-Requisites

[[MTH-211]]and [[CS-125]] (or equivalent programming experience).

CS-366. 3 DIMENSIONAL ENVIRONMENTS AND ANIMATION
Credits: 3

This course will explore the foundations of 3-dimensional animation processes as they apply to multiple mediums. Students will build computer-based models and environments, texture, light, animate, and render content for Integrative Media projects or as stand-alone pieces. Cross-listed with [[IM-350]].
Click here for course fee.

Pre-Requisites

[[CS-126]] or [[IM-201]].

CS-367. COMPUTER GRAPHICS
Credits: 3
Fees:

Introduction to equipment and techniques used to generate graphical representation by computer. Discussion of the mathematical techniques necessary to draw objects in two- and three-dimensional space. Emphasis on application programming and the use of a high-resolution color raster display.
Click here for course fee.

Pre-Requisites

[[CS-226]].

CS-368. 3 DIMENSIONAL GAME DEVELOPMENT
Credits: 3

An overview of simulation, engine-based, and real-time game systems with a focus on theory, creation, and animation of three-dimensional models used within a game context. Cross-listed with [[IM-368]].
Click here for course fee.

Pre-Requisites

[[CS-366]]/IM 350 or [[CS-367]].

CS-370. SPECIAL PROJECTS
Credits: variable

Requirements: Senior standing and approval of the department chairperson.

CS-383. WEB DEVELOPMENT II
Credits: 3

An introduction to the development of dynamic, database-driven sites, including active server pages, PHP, authentication, session tracking and security, and the development of shopping cart and portal systems.
Click here for course fee.

Pre-Requisites

[[CS-283]]. [[CS-325]].

CS-391. SENIOR PROJECTS I
Credits: 1

Design and implementation of a software project under the direction of a faculty member. Students will normally work in teams. Detailed requirements and design documents are required and will be presented at the end of the semester. Offered every fall.
Click here for course fee.

Pre-Requisites

[[CS-334]] or [[CS-324]].

CS-392. SENIOR PROJECTS II
Credits: 2

Design and implementation of a software project under the direction of a faculty member. Students will normally work in teams. Production of a finished product, including software and documentation, is required. There will be an open forum presentation of the project at the end of the semester. Offered every spring.
Click here for course fee.

Pre-Requisites

[[CS-391]].

CS-399. COOPERATIVE EDUCATION
Credits: 1-6

Professional cooperative education placement in a private or public organization related to the student's academic objectives and career goals. In addition to their work experiences, students are required to submit weekly reaction papers and an academic project to a Faculty Coordinator in the student's discipline. See the Cooperative Education section of this bulletin for placement procedures. Requirements: Sophomore standing; minimum 2.0 cumulative GPA; consent of the academic advisor; and approval of placement by the department chairperson.

EE. ELECTRICAL ENGINEERING

EE-140. SCIENTIFIC PROGRAMMING
Credits: 3
Fees: $115

This course presents an introduction to computer programming with an emphasis on the techniques needed for data analysis and numerical problem solving for scientific and engineering applications. Basic programming idioms are presented including control structures, data types, methods for handling input and output as well as numerical methods such as array computing and vectorization. Emphasis is placed on proper software engineering practice as well as data analysis and presentation. Two hours of lecture and two hours of lab per week.

Pre-Requisites

Or Concurrent [[MTH-100]] or [[MTH-111]]

EE-211. ELECTRICAL CIRCUITS AND DEVICES
Credits: 3

Basic DC and sinusoidal AC analysis of circuits. Introductory principles of electronic circuits, operational amplifiers, filters, digital logic, energy conversion devices, and energy conversion schemes.

Co-Requisites

[[EE-283]] and [[MTH-112]] **Or Concurrent**

EE-216. CIRCUIT ANALYSIS I
Credits: 3
Fees: $115

Analysis of dc and sinusoidal ac circuits and power calculations. Network theorems. 2-hour lecture and 2-hour lab per week.

Pre-Requisites

Or Concurrent [[MTH-111]]

EE-217. CIRCUIT ANALYSIS II
Credits: 3

Three-phase circuits, mutually coupled circuits, filter circuits, transient circuits, two-port parameters. Introduction to electronic circuits.

Pre-Requisites

[[MTH-112]] or Concurrent and [[EE-216]] or [[EE-211]]

EE-222. MECHATRONICS
Credits: 3
Fees: $115

Electronic design automation for mechatronics system design, test, debug, control, and monitor; Sensor conditioning and digital conversion; Introduction to embedded software, sensor integration and modeling. Two hours of lecture and 3-hour lab per week.

Pre-Requisites

[[EE-140]], [[EE-217]], [[EE-285]], [[PHY-202]]

EE-241. DIGITAL DESIGN
Credits: 4

Boolean Algebra. Numbering Systems. Combinational logic design and minimization. Sequential system fundamentals, state machine and programmable logic. Three hours of lectures and one two-hour lab per week.
Click here for course fees.

Pre-Requisites

[[EE-283]] or [[EE-285]]

EE-247. PROGRAMMING FOR EMBEDDED APPLICATIONS
Credits: 3

Microcontroller hardware structures. Basic software concepts such as constants, variables, control structures and subroutine calls, based on the 'C' language and as translated to machine language. Mapping of compiled software to the memory of a microcontroller. Embedded programming principles. Basic interactions with peripherals. Interrupts and their use. Debugging. Three hours of lecture and lab per week.

Click here for course fee.

Pre-Requisites

[[EE-140]] or [[CS-125]].

EE-251. ELECTRONICS I
Credits: 3

Circuit concepts involving nonideal components, particularly diodes, bipolar transistors, and MOS transistors. Bias, load line and signal amplification principles. Analysis and design of power supply and amplifier circuits, including power amplifiers. Simulation of circuits for design and analysis.

Pre-Requisites

[[EE-211]] or [[EE-216]]

EE-252. ELECTRONICS II
Credits: 4

Analysis and design of analog integrated circuits at the transistor level. Single-stage, multistage amplifiers, and cascode stage; differential amplifier analysis; operational amplifiers & applications; feedback structures, output stages, and power amplifiers. Three hours of lecture and 3-hour lab per week.
Click here for course fees.

Pre-Requisites

[[EE-251]], [[MTH-112]], [[PHY-202]]

EE-271. SEMICONDUCTOR DEVICES
Credits: 4

Basic properties of semiconductors and their conduction processes, with special emphasis on silicon and gallium arsenide. Physics and characterizations of p-n junctions.. Homojunction and heterojunction bipolar transistors. Unipolar devices including MOS capacitor and MOSFET. Microwave and photonic devices. Three hours of lecture and one two-hour lab per week.

Pre-Requisites

[[CHM-117]], [[CHM-118]], [[PHY-202]], [[MTH211]]

EE-283. ELECTRICAL ENGINEERING LAB
Credits: 1
Fees: $115

Exercises on DC and AC circuits, resonant and filter circuits, operational amplifiers, and digital logic circuits. One two-hour lab per week.

Co-Requisites

Or Concurrent [[EE-211]]

EE-285. ELECTRICAL CIRCUITS LAB
Credits: 1
Fees: $115

Exercises on DC and AC circuits, three-phase circuits, operational amplifiers, resonant and filter circuits, and basic electronic circuits. One two-hour lab per week.

Pre-Requisites

Or Concurrent [[EE-217]]

EE-298. TOPICS IN ELECTRICAL ENGINEERING
Credits: 1-3

Selected topics in the field of electrical engineering. Requirements: Sophomore standing and permission of the instructor.
Click here for course fee for lab courses.

Pre-Requisites

Sophomore standing and permission of the instructor.

EE-314. CONTROL SYSTEMS
Credits: 3

Laplace transforms and matrices. Mathematical modeling of physical systems. Block diagram and signal flow graph representation. Time-domain performance specifications. Stability analysis, Routh-Hurwitz criterion. Steady state error analysis. Root-locus and frequency response techniques. Design and compensation of feedback systems. Introductory state space analysis. Two hours of lecture and one two-hour laboratory per week.
Click here for course fees.

Pre-Requisites

[[PHY-214]] and [[EE-217]] (or [[EE-211]])

EE-325. ENERGY CONVERSION DEVICES
Credits: 3

Magnetic circuit calculations. Principle of operation and applications of transformers, DC machines, synchronous machines, and induction motors. Applications of power electronics. Energy conversion schemes.

Pre-Requisites

[[EE-251]] and [[EE-217]]

EE-337. ENGINEERING ELECTROMAGNETICS I
Credits: 3

Waves and phasors; concepts of flux and fields; transmission line, Smith chart, and impedance matching; vector calculus; Maxwell's equations for electrostatic and magnetostatic fields.
Click here for course fees.

Pre-Requisites

[[MTH211]], [[MTH212]], [[PHY-202]].

EE-339. ENGINEERING ELECTROMAGNETICS II
Credits: 4
Terms Offered: Spring

Obtain an understanding of Maxwell's equations and be able to apply them to solving practical electromagnetic field problems. Fundamental concepts covered will include laws governing electrodynamics, plane wave propagation in different media, power flow, polarization, transmission and reflection at an interface, microwave networks, waveguides, radiation, and antennas. Experiment and computer simulation based laboratories are used to reinforce the course material. Three hours of lecture and one three-hour lab per week.

Click here for course fee.

Pre-Requisites

[[EE-337]].

EE-342. EMBEDDED SYSTEM DESIGN
Credits: 3

Principles of embedded computing systems: architecture, hardware/software components, interfacing, hardware/software co-design, and communication issues. Three hours of lecture and project per week.

Click here for course fee.

Pre-Requisites

Or Concurrent

[EE-222]], [[EE-241]], [[EE-247]] or [[CS-126]]

EE-345. COMPUTER ORGANIZATION
Credits: 3

Computer architecture and design, CPU, memory system, cache, data, input/output devices, bus architecture and control units. Processor types, instruction set and assembly language programming. Three hours of lecture and project per week.
Clicl here for course fees.

Pre-Requisites

[[EE-140]] or [[CS-125]], [[EE-222]], [[EE-241]].

EE-381. MICROFABRICATION LAB
Credits: 3

The theoretical and practical aspects of techniques utilized in the fabrication of bipolar junction transistors (BJTs). Includes crystal characteristics, wafer cleaning, oxidation, lithography, etching, deposition, diffusion, metallization, process metrics, and device characterization. One-and-a-half hour lecture and one three-hour lab per week.

Click here for course fee.

Pre-Requisites

Or Concurrent [[EE-271]], [[EE-251]]

EE-382. MODERN COMMUNICATION SYSTEMS
Credits: 4
Terms Offered: Spring

Fundamentals of analog and digital modulation, modeling random signals and noise in communication systems, and elements of digital receivers. Laboratory exercises provide hands-on experience with circuits and measurement instruments as well as an introduction to communication system simulation. Three hours of lecture and 3-hour lab per week.
Click here for course fee.

Pre-Requisites

[[EE-252]], [[PHY-214]], [[MTH-212]]

EE-391. SENIOR PROJECTS I
Credits: 1

Design and development of selected projects in the field of electrical engineering under the direction of a staff member. Technical as well as economic factors will be considered in the design. A professional paper and detailed progress report are required.Requirement: Senior standing in engineering.
Click here for course fees.

Pre-Requisites

[[PHY-202]], [[EE-241]], [[EE-222]], [[EE-252]], [[EE-271]], [[PHY-214]], [[EGM-320]]

Co-Requisites

Concurrent or after [[EE-381]], [[EE-314]], [[EE-325]], [[EE-337]]

EE-392. SENIOR PROJECTS II
Credits: 2

Design and development of selected projects in the field of selected projects in the field of electrical engineering under the direction of a staff member. Technical as well as economic factors will be considered in the design. This is a continuation of the [[EE-391]]. A professional paper to be presented and discussed in an open forum is required.
Click here for course fees.

Pre-Requisites

[[EE-391]].

EE-398. TOPICS IN ELECTRICAL ENGINEERING
Credits: 3

Requirement: Junior standing in engineering.

EE-399. COOPERATIVE EDUCATION-ELECTRICAL ENGINEERING
Credits: 0-6

Professional cooperative education placement in a private or public enterprise related to the student's academic objectives and career goals. In addition to their work experiences, students are required to submit weekly reaction papers, have discussions with the Faculty Coordinator in the student's discipline on a periodic basis, prepare a final report and prepare and give a presentation to the Faculty Coordinator on an academic project completed at the enterprise. The co-op option for credit can only be taken one time for up to 6 credits, depending on the quantity of work hours, the complexity of the work and report and presentation requirements.

Pre-Requisites

Junior standing in engineering and Faculty Coordinator approval required.

EGR. ENGINEERING

EGR-200. MATERIALS SCIENCE
Credits: 3

Application of materials properties to engineering design. Introduction to atomic arrangements, crystal structures, imperfection, phase diagrams, and structure-property relations. Fundamentals of iron, steel, and non-ferrous materials. The behavior of materials in environmental conditions.

Pre-Requisites
[[CHM-118]] or [[CHM-115]].

EGR-201. PROFESSIONALISM AND ETHICS
Credits: 1

Responsibility of an engineer as a professional; ethics in science and engineering; role of professional societies; recent trends in technological innovations; career planning. Review of professional exam. Requirement: Junior standing in engineering.

EGR-202. ENGINEERING PROFESSIONAL DEVELOPMENT I
Credits: 1

The subjects the student will learn and develop in this course are important in securing an internship, a spot in graduate school, or a professional position. This professional development course will allow the student to experience a variety of communicative activities that prepare a student to be an experienced, informed, and professional engineer. The student will be introduced to networking with professionals as well as provided with the ability to communicate skills to employers at job fairs or on-campus mentoring events. Emphasis will be placed on professional interactions as well as attendance at events and mastering the fundamentals of written resumes, cover letters, and creating professional profiles.

Pre-Requisites
Permission of the instructor.

EGR-203. ENGINEERING PROFESSIONAL DEVELOPMENT II
Credits: 1

The subjects the student will learn and develop in this course are important in securing an internship, a spot in graduate school, or a professional position. This professional development course will allow the student to experience a variety of communicative activities that prepare a student to be an experienced, informed, and professional engineer. The student will be introduced to networking with professionals as well as provided with the ability to communicate skills to employers at job fairs or on-campus mentoring events. Emphasis will be placed on professional interactions as well as attendance at events and mastering the fundamentals of written resumes, cover letters, and creating professional profiles.

Pre-Requisites
Permission of the instructor.

EGR-219. INTRODUCTION TO WEAPONS SYSTEMS
Credits: 3

Introduction to military weapons and warfare, with a focus on how the modern period has resulted in greater complexity and the development of weapons systems. Basic principles of explosives, internal and exterior ballistics, calculation of probabilities of hit given randomness, fire control, guidance algorithms, radar and other sensors, detection and tracking, nuclear weapons and their effects.

Co-Requisites
[[PHY-202]] concurrent or before

EGR-222. MECHATRONICS
Credits: 3

Introduction to mechatronics system design with emphasis on using sensors to convert engineering system information into an electrical domain, signal conditioning and hardware integration, programming, and using actuators to effect system changes.
Click here for course fees.

Pre-Requisites
[[EE-211]], [[EE-283]], [[ME-140]] and [[PHY-202]]

EGR-327. THIN FILM PROCESSING
Credits: 3

Nucleation and growth theory; crystalline, amorphous, epitaxial growth morphology. Deposition techniques like DC, RF, magnetron sputtering, ion beam sputtering, evaporation, chemical vapor deposition, physical vapor deposition. Structure, properties, and applications for specific thin film processing techniques.
Click here for course fees.

Pre-Requisites
[[EGR-200]], [[PHY-203]].

EGR-391. SENIOR PROJECTS I
Credits: 1

Design and development of selected projects in the field of engineering under the direction of a staff member. Technical as well as economic factors will be considered in the design. A professional paper and detailed progress report are required.
Click here for course fees.

Pre-Requisites
Senior standing in engineering

EGR-392. SENIOR PROJECTS II
Credits: 2

Design and development of selected projects in the field of engineering under the direction of a staff member. Technical as well as economic factors will be considered in the design. This is a continuation of [[EGR-391]]. A professional paper to be presented and discussed in an open forum is required.
Click here for course fees.

Pre-Requisites
[[EGR-391]]

EGR-399. COOPERATIVE EDUCATION
Credits: 0-6

Professional cooperative education placement in a private or public organization related to the student's academic objectives and career goals. In addition to their work experiences, students are required to submit weekly reaction papers and an academic project to a Faculty Coordinator in the student's discipline. See the Cooperative Education section of this bulletin for placement procedures. **Requirements:** Junior standing; minimum 2.0 cumulative GPA; consent of the academic advisor; and approval of placement by the department chairperson.

ME. MECHANICAL ENGINEERING

ME-140. SCIENTIFIC PROGRAMMING
Credits: 3

This course presents an introduction to computer programming with an emphasis on the techniques needed for data analysis and numerical problem solving for scientific and engineering applications. Basic programming idioms are presented including control structures, data types, methods for handling input and output as well as numerical methods such as array computing and vectorization. Emphasis is placed on proper software engineering practice as well as data analysis and presentation.

Click here for course fees

Co-Requisites
[[MTH-111]] concurrent or before

ME-175. MACHINING
Credits: 1

Familiarizing with traditional machining processes and measuring equipment used in manufacturing. Hands-on experience with traditional and numerical control (NC) machines; various manufacturing processes and fundamentals of metrology.
Click here for course fees.

ME-180. CADD LAB
Credits: 1

An introduction to the symbolic and visual languages used in the various engineering fields. The use of the computer in design and drafting and familiarization with various software packages in the CADD (Computer Aided Design and Drafting) laboratory. Blueprint reading and printed circuit layouts. Emphasis will also be placed on the representation and interpretation of data in graphical form as well as the fundamentals of 2-dimensional and 3-dimensional graphic formats.
Click here for course fees.

ME-215. MANUFACTURING PROCESSES
Credits: 3

An introduction to manufacturing which examines traditional processes such as metal forming and casting and advanced manufacturing processes associated with thin film deposition, microfabrication and piezoelectric devices. Quality assurance and quality control issues in manufacturing.

Pre-Requisites
[[ME-232]]

ME-231. STATICS
Credits: 3

Statics of particles, including resolution of forces into components, vector sums, and concurrent force systems. Statics of rigid bodies and the study of moments. Equilibrium of bodies in two- and three-dimensions and determination of reactions. Analysis of trusses and frames. Determination of centroids and moments of inertia. Kinematics of particles, including displacement, velocity, and acceleration.

Pre-Requisites
[[PHY-201]]

Co-Requisites
[[MTH-112]] concurrent or before
[[ME-180]] concurrent or before

ME-232. STRENGTH OF MATERIALS
Credits: 3

Analysis of statically determinate and indeterminate structural systems; computation of reactions, shears, moments, and deflections of beams, trusses, and frames. Bending and torsion of slender bars; buckling and plastic behavior.

Pre-Requisites
[[ME-231]], [[ME-180]], [[MTH-112]], and [[EGR-200]] or [[CHM-115]].

ME-234. DYNAMICS
Credits: 3

This course continues the development of Newtonian mechanics with application to the motion of free bodies and mechanisms. Topics include rectilinear motion, vector calculus, particle motion, inertial and rotating reference frames, rigid body motion, rotational dynamics, linear and rotational momentum, work and kinetic energy, virtual work and collision.

Pre-Requisites
[[ME-231]], [[ME-180]], [[MTH-112]]

ME-298. TOPICS IN MECHANICAL ENGINEERING
Credits: 1-3

Selected topics in the field of mechanical engineering.

Pre-Requisites
Sophomore standing and permission of the instructor.

ME-312. MANUFACTURING SYSTEM ENGINEERING
Credits: 3

Fundamentals of manufacturing processes and systems. Analytical models of manufacturing processes including metal removal rate, tool wear, setup and tool change times. Analysis and optimization of manufacturing productivity and throughput. Automation and computer control of manufacturing processes.

Pre-Requisites
Junior standing in mechanical engineering.

ME-314. INVERSE PROBLEMS IN MECHANICS
Credits: 3

Inverse problems are very common in engineering where the outputs are known but the inputs are unknown. This course will show how to properly setup a well-posed inverse problem, how to solve matrix inverses, and conduct hands on experiments by creating strain gage based force transducers.

Pre-Requisites

[[ME-333]]

ME-317. ROBOTICS
Credits: 3

The analysis and design of robots. Class covers the mechanical principles governing the kinematics of robotics. Course topics include forward kinematics and the determination of the closed form kinematic inversion, as well as workspace and trajectory generation. Class also covers the formation and computation of the manipulator Jacobian matrix.

Click here for course fee.

Pre-Requisites

[[EGR-222]] and [[ME-234]]

Co-Requisites

[[MTH-212]] concurrent or before

ME-321. FLUID MECHANICS
Credits: 3

Thermodynamics and dynamic principles applied to fluid behavior and to ideal, viscous and compressible fluids under internal and external flow conditions.

Pre-Requisites

[[ME-231]]

Co-Requisites

[[ME-322]] concurrent or before

ME-322. THERMODYNAMICS
Credits: 3

The fundamental concepts and laws of thermodynamics, thermodynamic properties of perfect and real gases, vapors, solids, and liquids. Applications of thermodynamics to power and refrigeration cycles and flow processes. Development of thermodynamic relationships and equations of state. Review of the first and second laws of physics. Reversibility and irreversibility.

Pre-Requisites

[[MTH-112]]

ME-323. FLUID MECHANICS LABORATORY
Credits: 1

Experiments with and analysis of basic fluid phenomena, hydrostatic pressure, Bernoulli theorem, laminar and turbulent flow, pipe friction, and drag coefficient.
Click here for course fees.

Co-Requisites

[[ME-321]] concurrent or before
[[ME-322]] concurrent or before

ME-324. HEAT TRANSFER
Credits: 3

Fundamental principles of heat transmission by conduction, convection, and radiation; application of the laws of thermodynamics; application of these principles to the solution of engineering problems.

Pre-Requisites

[[ME-321]] and [[MTH-211]]

ME-325. ENERGY SYSTEMS
Credits: 3

Fundamental principles of energy transmission and energy conversion. Comprehension of the physical systems in which the conversion of energy is accomplished. Primary factors necessary in the design and performance analysis of energy systems.

Pre-Requisites

[[ME-322]].

ME-326. HEAT TRANSFER LABORATORY
Credits: 1

Basic heat transfer modes are demonstrated experimentally. This includes conduction, convection, and radiation of heat as well as fin and heat exchanger.
Click here for course fees.

Pre-Requisites

[[ME-321]]

Co-Requisites

[[ME-324]] concurrent or before

ME-328. COMBUSTION ENGINES
Credits: 3

Investigation and analysis of internal and external combustion engines with respect to automotive applications. Consideration of fuels, carburetion, combustion, detonation, design factors, exhaust emissions and alternative power plants.

Pre-Requisites

[[ME-322]]

ME-330. VIBRATIONS LABORATORY
Credits: 1
Fees: 115

Experiments that complement vibration theories in ME 332, including spring and damper elements, underdamped vibration, torsional pendulum, resonance, transient and steady-state behaviors, base excitation, rotating unbalance, impulse response, and modal testing.
Click here for course fee.

Pre-Requisites

[[ME-234]], [[MTH-211]]

Co-Requisites

[[ME-332]] concurrent or before

ME-332. VIBRATIONS
Credits: 3

An introductory course in mechanical vibration dealing with free and forced vibration of single and multi-degrees of freedom for linear and nonlinear systems.

Pre-Requisites

[[ME-234]], [[MTH-211]]

ME-333. MACHINE DESIGN
Credits: 3

The first course of a two-course sequence in design of machine elements dealing with theories of deformation and failure, strength and endurance limit, fluctuating stresses, and design under axial, bending, torsional, and combined stresses. A study of column buckling, fasteners, and gears.

Pre-Requisites

[[ME-232]]

ME-335. FINITE ELEMENT METHODS
Credits: 4

Introduction to finite element method for static and dynamic modeling and analysis of engineering systems. Finite element formulation and computer modeling techniques for stress, plane strain, beams, axisymmetric solids, heat conduction, and fluid flow problems. Solution of finite element equation and post processing of results for further use in the design problem.
Click here for course fee.

Pre-Requisites

[[ME-232]]

Co-Requisites

[[MTH-211]] concurrent or before

ME-336. SOLID MECHANICS
Credits: 3

This course is an introduction to continuum mechanics, variational methods, including vectors and tensors, state of stress and compatibility equation, plain stress and strain. Energy Principles and virtual work will be discussed.

Pre-Requisites

[[ME-232]]

ME-337. MICRO-ELECTRO-MECHANICAL SYSTEMS ENGINEERING
Credits: 3

This course explores the principles of MEMS by understanding materials properties, micro-machining, sensor and actuator principles. The student will learn that MEMS are integrated micro-devices combining mechanical and electrical systems, which convert physical properties to electrical signals and, consequently, detection. This course provides the theoretical and exercises the hands-on experience by fabricating a micro-pressure sensor.
Click here for course fees.

Pre-Requisites

Junior standing in engineering

ME-338. ADVANCED MACHINE DESIGN
Credits: 3

An advanced course in machine design topics that expands upon the concepts of Machine Design ([[ME-333]]). This course goes into more detail of the basic machine fundamentals introduced previously such as levers, belts, pulleys, gears, cams and power screws. Emphasis is also placed on 3D printing and the future of additive manufacturing.

Pre-Requisites

[[ME-333]]

ME-340. HEATING, VENTILATION AND AIR CONDITIONING
Credits: 3

Introduction of fundamentals of HVAC design and construction. Study of the psychometric process and fundamental calculations and layout of HVAC systems. Calculations of heat loss and heat gain in commercial and residential structures.

Pre-Requisites

[[ME-322]]

ME-343. ADDITIVE MANUFACTURING
Credits: 3

An introduction to additive manufacturing, also known as 3-D printing, which is a process of building 3-D objects from a digital file. Emphasis will be placed on both existing and emerging additive manufacturing processes in the context of design, modeling, materials, processing, and applications. This course provides hands-on experience and implements active learning strategies.
Click here for course fees.

Pre-Requisites

[[ME-333]]

ME-380. ADVANCED CADD
Credits: 3

An advanced course in Computer-Aided Drafting and Design (CADD) using SolidWorks. This course will introduce topics such as advanced modeling, advanced assemblies, Finite Element Analysis (FEA), and sheet metal.

Pre-Requisites

[[ME-180]], [[ME-335]]

ME-384. MECHANICAL DESIGN LABORATORY
Credits: 3

A laboratory for the development of open-ended problems in mechanical systems. Emphasis on experimental performance, data collection, evaluations, analysis, and design. This course provides hands-on experience with strain gauge application, measurement techniques, and analysis of topics in mechanical engineering.
Click here for course fees.

Pre-Requisites

[[ME-333]] and [[ME-335]]

ME-391. SENIOR PROJECTS I
Credits: 1

Design and development of selected projects in the field of mechanical engineering under the direction of a staff member. Technical as well as economic factors will be considered in the design. A detailed progress report is required.
Click here for course fees.

Pre-Requisites

Senior standing in Mechanical Engineering or departmental permission.

ME-392. SENIOR PROJECTS II
Credits: 2

Design and development of selected projects in the various fields of mechanical engineering under the direction of a staff member. Technical as well as economic factors will be considered in the design. A professional paper and detailed progress reports are required. This is a continuation of [[ME-391]]. An open-forum presentation and discussion of the professional paper are required.
Click here for course fees.

Pre-Requisites

[[ME-391]]

ME-395. INDEPENDENT RESEARCH
Credits: 1 - 3

Independent study and research for advanced students in the field of mechanical engineering under the direction of a staff member. A research paper at a level significantly beyond a term paper is required.

Pre-Requisites

Senior standing in mechanical engineering and approval of the department chairperson is required.

ME-396. INDEPENDENT RESEARCH
Credits: 1 - 3

Independent study and research for advanced students in the field of mechanical engineering under the direction of a staff member. A research paper at a level significantly beyond a term paper is required.

Pre-Requisites

Senior standing in mechanical engineering and approval of the department chairperson is required.

ME-397. SEMINAR
Credits: 1-3

Presentations and discussions of selected topics.

Pre-Requisites

Junior or Senior standing in mechanical engineering or special departmental permission.

ME-398. TOPICS IN MECHANICAL ENGINEERING
Credits: 1-3

Click here for course fees.

Pre-Requisites

Junior or senior standing in mechanical engineering.

ME-399. COOPERATIVE EDUCATION
Credits: 0-6

Professional cooperative education placement in a private or public organization related to the student's academic objectives and career goals. In addition to their work experiences, students are required to submit weekly reaction papers and an academic project to a Faculty Coordinator in the student's discipline. See the Cooperative Education section of this bulletin for placement procedures. Requirements: minimum junior standing in Engineering; 2.0 cumulative GPA; consent of the academic advisor; and approval of placement by the department chairperson. The co-op option for credit can only be taken one time for either 3 or 6 credits.

PHY. PHYSICS

PHY-198-298-398. TOPICS IN PHYSICS
Credits: variable

Selected topics in the field of physics. These may include one or more of the following: astronomy; geophysics; biophysics; nuclear power and waste; relativity; quantum mechanics; semi-conductors; cryogenics; health physics. May be repeated for credit.

Pre-Requisites

Varies with topic studied.

PHY-395-396. INDEPENDENT RESEARCH
Credits: 1 - 3

Independent study and research for advanced students in the field of physics under the direction of a staff member. A research paper at a level significantly beyond a term paper is required.

Pre-Requisites

Senior standing and approval of the department chairperson.

PHY-105. CONCEPTS IN PHYSICS
Credits: 3

Basic concepts of physical science, including the scientific method, will be studied. Theories, laws, and experiments from mechanics, electricity and magnetism, thermodynamics, optics, and atomic and nuclear physics may be included. Viewpoints will be classical and modern, including quantum and relativistic. Class meets for four hours per week: two hours of lecture and one two-hour lab each week.
Click here for course fees.

Pre-Requisites

No previous background in either science or college-level mathematics is required.

PHY-140. SCIENTIFIC PROGRAMMING
Credits: 3

This course presents an introduction to computer programming with an emphasis on the techniques needed for data analysis and numerical problem solving for scientific and engineering applications. Basic programming idioms are presented including control structures, data types, methods for handling input and output as well as numerical methods such as array computing and vectorization. Emphasis is placed on proper software engineering practice as well as data analysis and presentation. Two hours of lecture and two hours of laboratory per week.

Pre-Requisites

Or Concurrent

[[MTH-100]] or [[MTH-111]]

PHY-171. PRINCIPLES OF CLASSICAL AND MODERN PHYSICS
Credits: 4

An introductory course designed to promote and understanding of the more important fundamental laws and methods of mechanics and electricity and magnetism. Laboratory work to emphasize basic principles and to acquaint the student with measuring instruments and their use, as well as the interpretation of experimental data. Three hours of demonstration and lecture, one hour of recitation, and two hours of lab per week. Co-requisite: [[MTH-111]]
Click here for course fees.

PHY-174. APPLICATION OF CLASSICAL AND MODERN PHYSICS
Credits: 4

An introductory course designed to promote an understanding of the more important fundamental laws and methods of heat, optics, and modern physics. Laboratory work to emphasize basic principles and to acquaint the student with measuring instruments and their use, as well as the interpretation of experimental data. Three hours of demonstration and lecture, one hour of recitation, and two hours of lab per week. Co-requisite: [[MTH-111]]
Click here for course fees.

PHY-201. GENERAL PHYSICS I
Credits: 3

A thorough grounding in the concepts, principles, and laws of mechanics, and wave motion. Instruction by demonstration and lecture, recitation, and problem solving. Four hours of demonstration and lecture per week.

Click here for course fee.

Co-Requisites

[[MTH-111]] and [[PHY-204]]

PHY-202. GENERAL PHYSICS II
Credits: 3

A thorough grounding in the concepts, principles, and laws of Electricity and magnetism, optics and light. Instruction by demonstration and lecture, recitation, and problem solving. Four hours of demonstration and lecture per week.

Click here for course fee.

Pre-Requisites

[[PHY-201]]

Co-Requisites

[[MTH-112]]
[[PHY-205]]

PHY-203. MODERN PHYSICS
Credits: 3

Modern physics including the experimental basis, concepts, and principles of atomic and nuclear physics. Three hours of demonstration and lecture per week.

Pre-Requisites

[[PHY-202]].

PHY-204. GENERAL PHYSICS I LAB
Credits: 1
Fees: $100

This is a one-semester introductory physics laboratory course for science and engineering students. Experiments are performed to reinforce the concepts learned in PHY 201. Includes one two-hour laboratory exercise per week.

Co-Requisites

[[PHY-201]]

PHY-205. GENERAL PHYSICS II LAB
Credits: 1
Fees: $100

This is a one-semester introductory physics laboratory course for science and engineering students. Experiments are performed to reinforce the concepts learned in PHY 202. Includes one two-hour laboratory exercise per week.

Pre-Requisites

[[PHY-204]]

Co-Requisites

[[PHY-202]]

PHY-206. MODERN PHYSICS LAB
Credits: 1
Fees: $150

This intermediate level laboratory course offers a modern view of some of the famous experiments in the history of physics leading to the development of relativity and quantum theory. Additionally, the experiments are designed to prepare students to conduct experiments in contemporary physics labs. In doing so, this course presents a hands-on experience to reinforce the learning of fundamental concepts in EM theory, relativity, statistical mechanics, quantum mechanics, solid state physics, atomic physics, and nuclear physics.

Click here for course fee.

Pre-Requisites

[[PHY-201]] and [[PHY-202]]

Co-Requisites

[[PHY-203]]

PHY-214. APPLIED PHYSICS
Credits: 3

Modeling of various problems in physical, chemical, biological, and environmental sciences, particularly physical dynamical systems; Includes application of ordinary differential equations, and Laplace, Fourier, and Z transforms to continuous and discrete processes, matrix mechanics and eigenvalue problems, statistics and probability, random processes and distribution functions.
2 hours of lecture and 2 hours of laboratory per week.

Click here for course fee.

Pre-Requisites

[[MTH-211]]

PHY-311. THERMODYNAMICS & STATISTICAL MECHANICS
Credits: 3

This course focuses on the laws of thermodynamics and other thermodynamic concepts including entropy, free energy, equilibrium, and fluctuations as well as their pivotal role in physics and other scientific disciplines. Topics in statistical mechanics will be covered including partition functions, ensembles, kinetic theory, and phase transitions. Three hours of lecture per week.

Pre-Requisites

[[PHY-203]] and [[MTH-211]].

PHY-312. ANALYTICAL MECHANICS
Credits: 3

Employs advanced mathematical tools to study applications in complex mechanical systems. It offers an advanced differential reformulation of Newton's laws to study dynamical systems in multiple dimensions, conservative force fields, damped and driven oscillations, two-body problem, central forces and planetary motion, and the rotational dynamics of rigid bodies. Additionally, the course delivers a thorough grounding on the calculus of variations, Lagrange's formalism and Hamiltonian mechanics, all being the essential foundations for the development of modern physics (relativity, quantum mechanics, and quantum field theory). Three hours of lecture per week.

Pre-Requisites
[[PHY-202]] and [[MTH-211]].

PHY-314. QUANTUM MECHANICS
Credits: 3

This course presents an intermediate level of Quantum Mechanics using the abstract formulation of linear vector spaces in the Dirac formalism. Topics covered include: spin, addition of angular momentum, scattering and bound particles, the harmonic oscillator, two-body problem and central potential wells in 3D, H-atom and H-like atoms, time-independent perturbation theory, identical particles and the He-atom. In addition to the foundations of Quantum Mechanics, the course offers a selection of advanced and modern topics like entanglement and quantum teleportation. Three hours of lecture per week.

Pre-Requisites
[[PHY-203]], [[CHM-115]], [[MTH-211]], and [[MTH-212]].

PHY-374. IMAGING IN BIOMEDICINE
Credits: 3

This course will cover different aspects of imaging important to medicine and biomedicine including optical microscopy, scanning probe microscopy, scanning electron microscopy, magnetic resonance, ultrasound X-ray, nuclear radiation, microwave and electro-/magneto-encephalographic techniques as well as image processing. Three hours of lecture and three hours of lab per week.
Click here for course fee.

Pre-Requisites
[[PHY-201]] & [[PHY-202]] or [[PHY-171]] & [[PHY-174]], [[MTH-112]].

PHY-377. BIOPHYSICS
Credits: 3

This course presents an overview of the important physical principles governing the behavior of cells and macromolecules. Upper-level mathematics that are useful to understand these phenomena are introduced in a way that is comprehensible to biology majors lacking background beyond basic calculus. In addition to the physical models governing the most ubiquitous molecular and cellular processes, the physics behind the most common experimental techniques used in biology, bioengineering, and biophysics are covered. Three hours of lecture and two hours of lab per week.

Pre-Requisites
[[PHY-201]] & [[PHY-202]] or [[PHY-171]] & [[PHY-174]], [[MTH-112]].

PHY-391. SENIOR PROJECT I
Credits: 1

Students will plan and execute a research project in the field of physics or at the intersection of physics and another related discipline. Projects can be theoretical, experimental or both and can include the design of unique experiments and simulations. A detailed progress report and presentation are required. Students pursuing a dual degree or double major may be eligible to combine this project with the capstone project of another program (subject to the approval of their advisors in both programs).
Click here for course fee.

Pre-Requisites
Senior standing in Physics

PHY-392. SENIOR PROJECT II
Credits: 2

Students will plan and execute a research project in the field of physics or at the intersection of physics and another related discipline. This is a continuation of PHY 391. A professional paper and progress report are required. Students will present the results of their work in an open-forum. Students pursuing a dual degree or double major may be eligible to combine this project with the capstone project of another program (subject to the approval of their advisors in both programs).
Click here for course fee.

Pre-Requisites
[[PHY-391]]