ELECTRICAL ENGINEERING

Electrical Engineering

Electrical Engineering Major - Required Courses and Recommended Course Sequence

First Semester

[[MTH-111]] Calculus I	4
[[CHM-117]] Chemistry Lab for Engineers	1
[[CHM-118]] Chemistry for Engineers	3
[[ME-180]] CADD Lab	1
[[ENG-101]] English Composition	4
[[FYF-101]] First-Year Foundations	3
	16

Second Semester

[[MTH-112]] Calculus II	4
[[PHY-201]] General Physics I	3
[[PHY-204]] General Physics I Lab	1
[[EE-140]] Scientific Programming	3
[[EE-216]] Circuit Analysis I	3
General Education	3
	17

Third Semester

[[MTH-211]] Intro. to Differential Equations	4
[[PHY-202]] General Physics II	3
[[PHY-205]] General Physics II Lab	1
[[EE-217]] Circuit Analysis II	3
[[EE-285]] Electrical Circuits Lab	1
[[ME-231]] Statics	3
	15

Fourth Semester

[[MTH-212]] Multivariable Calculus	4
[[EE-251]] Electronics I	3
[[EE-222]] Mechatronics	3
[[EE-241]] Digital Design	4
General Education	3
	17

Fifth Semester

[[EE-252]] Electronics II	4
[[EE-271]] Semiconductor Devices	4
[[EE-381]] Microfabrication Lab	3
Technical Elective*	3
General Education	3
	17

Sixth Semester

[[EGR-399]] Cooperative Education** **OR**	
Technical Electives*	3
[[PHY-203]] Modern Physics	3
[[PHY-206]] Modern Physics Lab	1
[[EGR-201]] Professionalism and Ethics	1
[[PHY-214]] Applied Physics	3
General Education	3
[[EGM-320]] Engineering Project Analysis	3
	17

Seventh Semester

[[EE-314]] Control Systems	3
[[EE-337]] Electromagnetics I	3
[[EE-391]] Senior Project I	1
[[EE-325]] Energy Conversion Devices	3
General Education	6
	16

Eighth Semester

[[EE-339]] Electromagnetics II	4
[[EE-382]] Modern Communication Systems	4
[[EE-392]] Senior Projects II	2
Technical Elective*	3
Free Elective***	2
	15

**Two technical elective courses must be taken from Electrical Engineering and Physics courses; the third technical elective course may be from EE or other engineering departments. All technical electives must be advisor approved.*

***Students must consult with the Cooperative Education Coordinator to determine availability and proper scheduling of the Cooperative Education experience.*

**** Free elective may be chosen from any course numbered 101 or above.*

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.
Click here for course fees.

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.
Click here for course fees.

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.
Click here for course fees.

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.
Click here for course fees.

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.
Click here for course fees.

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.

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.
Click here for course fee.

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.
Click here for course fee.

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]]