

Electrical Engineering

College of Science, Engineering and Technology
 Department of Electrical & Computer Engineering and Technology
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Electrical Engineering (EE) encompasses research, development, design and operation of electrical and electronic systems and their components. This program leads to a Bachelor of Science in Electrical Engineering (BSEE). The primary objective of the Electrical Engineering program is to educate engineering professionals who possess a sound design and analytical background coupled with a strong laboratory experience. This means that the department expects to prepare its graduates for:

1. Entry into the engineering work environment with well developed design and laboratory skills.
2. Further study toward advanced degrees in engineering and other related disciplines.
3. Advancement into managerial ranks and/or entrepreneurial endeavors.

In support of this objective, the program provides a curriculum including the following components that follow the guidelines set forth by ABET:

1. A strong background in the physical sciences, mathematics, and the engineering sciences including extensive hands-on laboratory instruction.
2. An integrated design component to the curriculum including instruction in basic practices and procedures, creativity, control, economics, and synthesis. The process begins with basic instruction during the freshman year and concludes with a capstone design project.
3. A choice of several subdisciplines in their senior level elective offerings (digital, controls, communications, microelectronics design and fabrication).
4. Opportunities for students to develop sensitivity to the social and humanistic implications of technology and motivate them to make worthwhile contributions to the profession and society, while upholding the highest standards of professional ethics.
5. Courses in business and economics to promote awareness of management and the economic aspects of engineering.
6. Preparation for continuing study and professional development.

The curriculum offers students the opportunity to emphasize a number of specialized areas including digital systems, wireless communications, controls, and material sciences. During the senior year, students must take the first step toward registration as a professional engineer by taking the Fundamentals of Engineering, (FE) examination. The electrical engineering program is accredited by the Engineering Accreditation Board for Engineering and Technology (ABET).

MSU offers a 3/2 program with regional Liberal Arts colleges. Contact the department for more information.

Recommended high school preparation is two years of algebra, one year of geometry, one-half year of trigonometry, one-half year of college algebra, and a year each of physics and chemistry. Without this background it may take longer than four years to earn the degree. The first two years students take science and mathematics courses common to all branches of engineering (pre-engineering), as well as supporting work in English, humanities and social sciences. Second-year electrical engineering students complete physics, mathematics and 200-level engineering science courses. Some specialization for a particular engineering major occurs in the second year.

Admission to Major. Admission to the college is necessary before enrolling in 300- and 400-level courses. Minimum college admission requirements are:

- a minimum of 32 earned semester credit hours.
- a minimum cumulative GPA of 2.00 (C).

Contact the department for application procedures.

During the sophomore year, students should submit an application form for admission to the electrical engineering program. Admission to the program is selective and, following application to the department, subject to approval of the faculty. The department makes a special effort to accommodate transfer students and has joint admissions agreements with most community colleges. Only students admitted to the program are permitted to enroll in upper-division EE courses. No transfer credits are allowed for upper-division EE courses except by faculty review followed by special written permission.

Before being accepted into the program and admitted to 300-level electrical engineering courses (typically in the fall semester), a student must complete a minimum of 46 semester credits as follows:

- General Physics (calculus-based) (10 credits)
- Calculus and Differential Equations (16 credits)
- Electrical Engineering Circuit Analysis I and II (including laboratory) (7 credits)
- Chemistry (5 credits)
- English Composition (4 credits)
- Computer Sciences (FORTRAN, C, or C++) (2 credits)
- Statics and/or Dynamics (3 credits)

A cumulative grade-point average of 2.5 for all science, math and engineering courses must have been maintained. Grades must be C or better for courses to be accepted. MSU students should complete the pre-engineering courses listed under the major.

GPA Policy: Students graduating with a degree in Electrical Engineering must have 1) completed a minimum of 20 semester credit hours of upper division EE course work; 2) have a cumulative GPA of 2.25 or higher on all upper division MSU EE coursework; 3) have completed their senior design sequence at MSU; and 4) have taken the FE exam and achieved the competency level set by the department.

P/N Grading Policy: A student who majors in EE must elect the grade option for all required courses including general education courses listed by number even if offered by another department.

ELECTRICAL ENGINEERING BSEE

Required for Major (Prerequisites, 47 credits):

CHEM	201	General Chemistry I (5)
COMS	171	Intro. to C++ Programming (2)
EE	230	Circuit Analysis I (3)
EE	231	Circuit Analysis II (3)
EE	240	Evaluation of Circuits (1)
ENG	101	Composition (4)
MATH	121	Calculus I (4)
MATH	122	Calculus II (4)
MATH	223	Calculus III (4)
MATH	321	Ordinary Differential Equations (4)
ME	212	Statics (3)
PHYS	221	General Physics I (5)
PHYS	222	General Physics II (5)

Required for Major (General Studies, 19 credits):

ENG	271	Technical Communication (4) or
SPEE	233	Public Speaking for Technical Professionals (3)

* SPEE 102 Public Speaking (3) may be substituted.

Choose a minimum of 13 credits from Humanities and Social Sciences courses:

Humanities (6-7 credits)

HUM xxx HUM xxxHUM xxx

In general, graduation credit toward the humanities requirement is not allowed for any course in subject areas such as speech communication, writing, art, music, or theatre that involve performance or practice of basic skills. Courses acceptable by department or program include: ART 160, 260, 261, 413, 416, 419, 460, 462, 463, 466, 469; ENG 112, 113, 114, 271, 320, 321, 325, 327, 328, 331, 332, 400, 401, 402, 403, 405, 406, 416, 478, 479, 481; FOREIGN LANGUAGE 200 level or above; HIST all except 490 and higher; HUM 150, 155, 250, 251*,

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280, 281, 282; MASS 110, 411, 412; MUS 120, 125, 126, 220, 221, 222, 422, 423, 424, 425, 426, 429, 432; PHIL all except 490 and higher; SPEE 203, 300, 315-403, 412, 413; THEA 100, 252, 283, 285, 481, 482. For other acceptable courses, please consult with your advisor.

*Note: EET 125 may be substituted for HUM 250

Social Sciences (6-7 credits)

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Courses acceptable by department or program include: ANTH all courses except 480 and above; GEOG 100, 101, 103, 340, 341, 425, 430, 435, 437, 445, 446, 450, 454, 456; POL all except 420, 421, 422, 490 and above; PSYC all except 201, 202, 291, 303, 390, 391, 473 and above; SOC all except 201, 202, 466, 469, 470, 485 and above; URBS all except 301, 302, 481 and above; WOST all except 260, 277, 290, 320, 430, 460 and above. For other acceptable coursework, please consult your advisor.

At least 3 credits of the courses selected to complete the above requirements must be 300 level or above. At least one 300 level course must follow a lower level course in the same subject area.

Choose one course from the following:

ECON 201 Principles of Macroeconomics (3)

ECON 202 Principles of Microeconomics (3)

Required Core for Major (Engineering, 48 credits):

EE 101 Introduction to Engineering I (1)

ME 103 Introduction to Engineering III (1)

EE 244 Introduction to Digital Systems (2)

EE 254 Digital and Circuits Lab (1)

EE 303 Introduction to Solid State Devices (3)

EE 304 Introduction to Solid State Devices Lab (1)

EE 332 Electronic Circuits and Devices (4)

EE 333 Digital and Analog Electronic Systems (4)

EE 334 Microprocessor Engineering (3)

EE 337 Principles of Engineering Design (1)

EE 341 Signals and Systems (3)

EE 342 Electronics Design Laboratory (1)

EE 344 Design and Evaluation of Microprocessors (1)

EE 350 Engineering Electromagnetics (4)

EE 353 Communication Systems Engineering (2)

EE 358 Control Systems (3)

EE 363 Communication Systems Laboratory (1)

EE 368 Control Systems Laboratory (1)

EE 467 Principles of Engineering Design I (2)

EE 477 Principles of Engineering Design II (2)

EE 482 Electromechanics (3)

EE 488 Thermal Systems Engineering (2) or

ME 299 Thermal Analysis (2)

ME 291 Engineering Analysis (3) or MATH 354 Concepts of Probability and Statistics (3)

Required for Major (Business, 5 credits):

EE 250 Engineering Economics (2)

Choose one course from the following list:

BLAW 200, FINA 362, MGMT 330 or 440, MRKT 310

Required Electives for Major (9 credits):

Choose a minimum of 9 credits from the following courses. Two courses must be in sequence (same subject area):

EE 453 EE 462 EE 471 EE 472 EE 475

EE 476 EE 479 EE 480 EE 481 EE 484

EE 487

Required Minor: None.

No minor or other major accepted toward degree.

COURSE DESCRIPTIONS

EE 101 (1) Introduction to Engineering I

Discussion of historical, educational, and professional aspects of engineering. Problem solving, study approaches and techniques, and the motiva-

tion behind modern engineering education and practices. Lab sessions cover the basics of word processing, spreadsheets, databases, drawing, and graphing programs. As well as preparation of plan to graduation, and study techniques.

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EE 230 (3) Circuit Analysis I

This course is meant to develop Electrical Engineering Circuit Analysis skills in DC and AC circuits. It includes circuit laws and theorems, mesh and node analysis. Natural and step response of RL, RC, and RLC circuits.

Pre: PHYS 222 or concurrent, MATH 321 or concurrent F

EE 231 (3) Circuit Analysis II

Continuation of Circuit Analysis I to include special topics in circuit analysis.

Pre: EE 230 and 240, MATH 321, PHYS 222 S

EE 240 (1) Evaluation of Circuits

Laboratory support for EE 230. Use of laboratory instrumentation to measure currents and voltages associated with DC and AC circuits. Statistical analysis of measurement data. Measurements of series, parallel and series-parallel DC and AC circuits. Measurement of properties for circuits using operational amplifiers. Measurement of transient responses for R-L and R-C circuits. Simulation of DC and AC circuits using PSpice. Concepts covered in EE 230 will be verified in the laboratory. Prerequisites: Must be taken concurrently with EE 230.

F

EE 244 (2) Introduction to Digital Systems

A study of digital systems including number conversion, and the mathematical operations of addition, subtraction and multiplication using signed and unsigned binary numbers. The use of flip-flops, counters and shift registers and software tools to simulate digital circuit behavior.

Pre: MATH 122

EE 250 (2) Engineering Economics

Overview of accounting and finance and their interactions with engineering, manufacturing, marketing, R&D and sales. Lectures include the development and analysis of financial statements, time value of money, decision making tools, ratio analysis, cost of capital, depreciation, taxes, cash flow, rate of return and forecasting.

F

EE 253 (1) Logic Circuits Lab

Laboratory support to complement EE 244. Use of laboratory instrumentation to measure characteristics of various logic circuits and digital subsystems. Experimental evaluation of digital logic devices and circuits including logic gates, flip flops, and sequential machines. Some simulation and testing of programmable logic devices and digital integrated circuits will be included.

Pre: EE 230 and concurrently with EE 244 S

EE 254 (1) Digital and Circuits Lab

Laboratory support for EE 231 and EE 244. Experimental evaluation of AC and transient circuits, digital logic devices including logic gates, flip flops, and sequential machines. Some simulation and testing of PAL devices and memory IC's.

Pre: EE 230, 240 and concurrently with EE 231 and 244 S

EE 303 (3) Introduction to Solid State Devices

Introduction to crystal structure, energy band theory, conduction and optical phenomenon in semiconductors, metals and insulators. Study of equilibrium and non-equilibrium charge distribution, generation, injection, and recombination. Analysis and design of PN-junctions, (bipolar transistor, junction) and MOS field-effect transistors. Introduction to transferred electron devices and semiconductor diode laser.

Pre: PHYS 222, and MATH 321 F

EE 304 (1) Lab: Introduction to Solid State Devices

Laboratory support for EE 303. Experiments include resistivity and sheet resistance measurements of semiconductor material, probing material, probing of IC chips, PN-junction IV and CV measurements, BJT testing to extract its

parameters, MOSFET testing and evaluating its parameters, cv-measurements of MOS structure, and familiarization with surface analysis tools.

F

EE 332 (4) Electronics I

Semiconductor device characteristics of diodes, BJT's, JFET's, MOSFET's and GaAs FET's will be examined. DC bias circuits small signal, large signal, and PSPICE device modeling and analysis will be studied. Design and analysis will be conducted on small-signal amplifiers (single and multi-stage), power amplifiers, differential amplifiers, and feedback amplifier concepts.

Pre: EE 231, admission to EE program. F

EE 333 (4) Electronics II

This is the second course of the electronics sequence. Design and analysis skills will be developed by examining the 741 and related devices. Additional course topics include filters, tuned circuits, signal generators, and wave-shaping. Digital circuits including the basics of various forms of MOS and bipolar digital logic and memory will be studied.

Pre: EE 332 S

EE 334 (3) Microprocessor Engineering

Use of microprocessors and microcontrollers in engineering applications. Topics include assembly language programming, smart and programmable controllers, memory design including dynamic memory and direct memory access, bus standards and protocol, serial and parallel I/O, interfacing with other programmable systems, maskable and non-maskable interrupts.

Pre: EE 244 F

EE 337 (1) Principles of Engineering Design

Application of the design techniques in the engineering profession. Electrical engineering project and program management and evaluation including computer assisted tools for planning and reporting, design-to-specification techniques and economic constraints.

Pre: Admission to EE program S

EE 341 (2) Signals & Systems

Analysis of linear systems and signals in the time and frequency domain. Laplace and Fourier transforms. Z-transform and discrete Fourier transforms.

Pre: MATH 321 F

EE 342 (1) Electronics Laboratory

This lab is designed to accompany EE 332. The lab covers the experimental measurement and evaluation of diode, BJT, and MOS characteristics; various feedback topologies; oscillator and op-amp circuits; and rectifiers and filter circuitry.

Pre: EE 231 and 332 taken concurrently. F

EE 344 (1) Design & Evaluation of Microprocessors

Laboratory support for EE 334. Study of various single board computers through assembly language programming. Basic input/output, ports, memory, addressing, timers, A/D converters, serial and parallel communication protocol, and interrupt processing.

Pre: Concurrent with EE 334 F

EE 350 (4) Engineering Electromagnetics

Vector fields. Electrostatic charges, potential and fields; displacement. Steady current/current density; magnetostatic fields, flux density. Materials properties. Faraday's Law and Maxwell's equations. Skin effect. Wave propagation, plane waves, guided waves. Radiation and antennas. Transmission line theory.

Pre: MATH 223 and PHYS 222 S

EE 353 (2) Communication Systems Engineering

Signals and Systems, Fourier transforms, Parseval's theorem. Autocorrelation functions and spectral density functions. Information theory. Noise and noise figure, probability and statistics. Transformation of random variables, probability of error and bit error rate. Modulation and demodulation. Overview of analog, sampled analog and digital communication systems. Spread spectrum systems.

Pre: EE 332 S

EE 358 (3) Control Systems

Theory and principles of linear feedback control systems. Analysis of linear control systems using conventional techniques like block diagrams, Bode plots, Nyquist plots and root-locus plots. Introduction to cascade compensation: proportional, derivative and integral compensation. State space models.

Pre: EE 341 S

EE 363 (1) Communication Systems Laboratory

Measurement techniques using the oscilloscope, spectrum analyzer and network analyzer. Signals and spectra. Frequency response. Noise and noise figure measurements. Intermodulation products. Amplitude and frequency modulation/demodulation. Sampling, aliasing, and intersymbol interference. Bit error measurement.

Pre: Concurrent with EE 353 S

EE 368 (1) Control Systems Laboratory

Laboratory support for EE 358. Experimental evaluation of basic control system concepts including transient response and steady state performance. Analog and digital computers.

Pre: EE 341 and concurrent with EE 358 S

EE 380 (2) Advanced Digital

Combinational circuit design with Karnaugh map and tabular method; MSI building blocks; circuits of latches, flip-flops, and registers; design of counters; types of sequential circuits; design process for sequential circuits; minimization of sequential circuit design by performing state reduction and state encoding optimization; syntax and semantics of HDL language; HDL modeling and simulation techniques, implementation of digital system in complex programmable logic devices (CPLDs).

F

EE 439 (3) Electronics for Non-Electrical Engineering Majors

Topics covered include power supplies, operational amplifiers and feedback circuits, linear and nonlinear circuits and applications, analog switches, digital logic gates and devices, A/D and D/A converters, microprocessors, and basic control systems.

Pre: PHYS 221 and 222 Variable

EE 453 (3) Advanced Communications Systems Engineering

Behavior of analog systems and digital systems in the presence of noise, principles of digital data transmission, baseband digital modulation, baseband demodulation/detection, bandpass modulation and demodulation of digital signals. Channel coding, modulation and coding trade-offs, spread spectrum techniques, probability and information theory.

Pre: EE 353 and 363 F

EE 462 (3) Advanced Digital Systems

A study of finite state machine design, hardware description language, principles of instruction execution, instruction pipe lining, superscalar processor design, multiprocessor systems and memory system design.

Pre: EE 333 and 334 F

EE 467 (2) Principles of Engineering Design I

The design and organization of engineering projects. Project proposals, reporting, feasibility studies, and interpretation. Specification preparation, interpretation, and control. Issues involving creativity, project planning and control, and intellectual property rights. Students enrolled in this course must initiate and complete a design project in a small team format.

Pre: EE 337 and senior standing F

EE 471 (3) Advanced Control Systems

This course is a continuation of EE 358. Techniques for the analysis of continuous and discrete systems are developed. These techniques include pole placement, state estimation, and optimal control.

Pre: EE 358 and 368 F

EE 472 (3) Digital Signal Processing

Develop design and analysis techniques for discrete signals and systems via Z-transforms, Discrete Fourier Transforms, implementation of FIR and IIR filters. The various concepts will be introduced by the use of general and special purpose hardware and software for digital signal processing.

Pre: EE 341 S

EE 475 (3) Integrated Circuit Engineering

Introduction to theory and techniques of integrated circuit fabrication processes, oxidation, photolithography, etching, diffusion of impurities, ion implantation, epitaxy, metallization, material characterization techniques, and VLSI process integration, their design and simulation by SUPREM. Same as PHYS 467.

Pre: EE 303 and 332 F

EE 476 (3) Antennas, Propagation, & Microwave Engineering

Principles of electromagnetic radiation, antenna parameters, dipoles, antenna arrays, long wire antennas, Microwave antennas, Mechanisms of radiowave propagation, scattering by rain, sea water propagation, guided wave propagation, periodic structures, transmission lines, microwave/millimeter wave amplifiers and oscillators, MIC & MMIC technology.

Pre: EE 350 Variable

EE 477 (2) Principles of Engineering Design II

Completion of design projects and reports. Lectures on ethics, issues in contracting and liability, concurrent engineering, ergonomics and environmental issues, economics and manufacturability, reliability and product lifetimes. Lectures by faculty and practicing engineers.

Pre: EE 467 S

EE 479 (3) Superconductive Devices

Magnetic and superconducting properties of materials, microscopic theory of superconductivity and tunneling phenomenon. Josephson and SQUID devices, survey of computer memories, memory cell and shift register, A/D converters and microwave amplifiers. Integrated circuit technology and high temperature superconductors.

Pre: EE 303 Variable

EE 480 (1) Integrated Circuit Fabrication Lab

Introduction to integrated circuit fabrication processes, device layout, mask design, and experiments related to wafer cleaning, etching, thermal oxidation, thermal diffusion, photolithography, and metallization. Fabrication of basic integrated circuit elements pn junction, resistors, MOS capacitors, BJT and MOSFET in integrated form. Use of analytic tools for in process characterization and simulation of the fabrication process by SUPREM. Same as PHYS 468.

Pre: Concurrent with EE 475 F

EE 481 (1) VLSI Design Lab

This laboratory accompanies EE 484. The laboratory covers the basics of layout rules, chip floor planning, the structure of standard cells and hierarchical design, parasitic elements, routing, and loading. Students will learn to design and layout standard cells as well as how to use these cells to produce complex circuits. The laboratory culminates with the individual design and layout of a circuit.

Pre: Concurrent with EE 484 S

EE 482 (3) Electromechanics

Electrical power and magnetic circuit concepts, switch-mode converters, mechanical electromechanical energy conversion, DC motor drives, feedback controllers, AC machines and space vectors, permanent magnet AC machines and drives, induction motors and speed control of induction motors, stepper motors.

Pre: EE 230 F

EE 484 (3) VLSI Design

The basics of digital VLSI technology. Bipolar and MOS modeling for digital

circuits. Physical transistor layout structure and IC process flow and design rules. Custom CMOS/BICMOS static and dynamic logic styles, design and analysis. Clock generation, acquisition, and synchronization procedures. Special purpose digital structures including memory, Schmitt triggers, and oscillators. Individual design projects assigned.

Pre: EE 333 S

EE 487 (3) RF Systems Engineering

Overview of wireless communication and control systems. Characterization and measurements of two-port RF/IF networks. Transmission lines. Smith chart. Scattering parameters. Antenna-preselector-preamplifier interface. Radio wave propagation. Fading. RF transistor amplifiers, oscillators, and mixer/modulator circuits. Multiple access techniques. Transmitter/receiver design considerations. SAW matched filters.

Pre: EE 353 and 363 Variable

EE 488 (2) Thermal Systems Engineering

Thermodynamic concepts, properties and laws. Thermodynamic cycles and energy conversion; control volume analysis. Heat transfer by conduction, convective flow and radiation. Heat sink design. Design problems in electronics packaging, reliability, thermoelectric effects and cooling devices. Environmental property sensors.

Pre: PHYS 222 and EE 333 Variable

EE 491 (1-4) In-Service

EE 497 (1-6) Internship

EE 499 (1-6) Individual Study
