Computer Engineering

College of Science, Engineering & Technology
Department of Electrical and Computer Engineering and Technology
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Computer Engineering (CE) encompasses the research, development, design and operation of computers and computerized systems and their components. The primary objective of the Computer 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.
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 economics to promote awareness of 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 advanced digital systems, communications, digital signal processing, networking, and system design.

The 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 plus a programming language. Without this background it may take students longer than four years to earn a degree. During 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 computer engineering students complete physics, mathematics and 200-level engineering and computer science courses.

Admission to Major. Admission to the college is necessary before enrolling in non-engineering 300- and 400-level courses. Minimum college requirements are:
- a minimum of 32 earned semester credit hours.
- a minimum cumulative GPA of 2.00 (C).
Please contact the department for application procedures.

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

Before being accepted into the program and admitted to 300-level engineering courses (typically in the fall semester), a student must complete a minimum of 48 semester credits as follows:
- General Physics (calculus-based) (10 credits)
- Calculus, Differential Equations, Probability & Statistics (15 credits)
- Electrical Engineering Circuit Analysis I and II (including laboratory) (7 credits)
- Chemistry (5 credits)

- English Composition (4 credits)
- Computer Sciences (Java and C++) (6 credits)

A cumulative GPA of 2.5 for all science and math courses must have been achieved for program admittance. Grades must be "C" or better for courses to be accepted.

GPA Policy. Students graduating with a degree in Computer Engineering must have:
1. completed a minimum of 20 semester credit hours of upper division EE and COMS courses at MSU.
2. have a cumulative GPA of 2.25 on all upper division EE and COMS courses, and
3. have completed their senior design sequence at MSU.
4. have taken the Fundamentals of Engineering (FE) exam and achieved the desired competency level.

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

COMPUTER ENGINEERING BSEC

Required for Major (Prerequisites, 61 credits):

CHEM	201	General Chemistry I (5)
COMS	110	Foundations of Computer Sci. (4)
COMS	211	Fundamentals of Computer Sci. I (4)
COMS	212	Fundamentals of Computer Sci. II (4)
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)
EE	244	Intro. to Digital Systems (2)
EE	254	Digital and Circuits Lab (1)
ENG	101	Composition I (4)
ENG	271	Technical Communication (4) OR
SPEE	233	Public Speaking for Technical Professionals (3) OR
SPEE	102	Public Speaking (3)
MATH	121	Calculus I (4)
MATH	122	Calculus II (4)
MATH	321	Ordinary Differential Equations (4)
MATH	354	Concepts of Probability and Statistics (3) OR
ME	291	Engineering Analysis (3)
PHYS	221	General Physics I (5)
PHYS	222	General Physics II (5)

Required for Major (additional General Studies) Additional Supporting Studies (13 credits)
Choose a minimum of 13 credits from the following Humanities and Social Sciences courses:

Humanities (6-7 credits)
Courses acceptable by department or program include:
ART 160, 260, 261, 413, 416, 419, 460, 462, 463, 466, 469; ENG 112, 113, 114, 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, 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.
* Note: EET 125 may be substituted for HUM 250

Social Sciences (6-7 credits)
Courses accepted 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.

In general, graduation credits toward the humanities requirement is not al-

lowed for any course in subject areas such as speech communication, writing, art, music or theater that involve performance or practice of basic skills.

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.

In addition, you must select one course from the following:
ECON 201 Principles of Macroeconomics (3)
ECON 202 Principles of Microeconomics (3)

Required for Major (Engineering Plus Computer Science, 52-53 credits):
COMS 310 Data Structures and Algorithms (4)
COMS 320 Machine Structures and Programming (4)
COMS 380 Systems Analysis and Design (4)
COMS 460 Operating Systems (4)
COMS 462 Communication Protocols (4) (COMS 362 is pre-req.)
EE 250 Engineering Economics (2)
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 342 Electronics Design Laboratory (1)
EE 344 Design and Evaluation of Microprocessors (1)
EE 353 Communication Systems Engineering (2)
EE 363 Communication Systems Laboratory (1)
EE 380 Advanced Digital (2)
EE 462 Advanced Digital Systems (3)
EE 467 Principles of Engineering Design I (2)
EE 477 Principles of Engineering Design II (2)
EE 453 Advanced Communications Systems Engineering (3) OR
EE 484 VLSI Design (3)

Required Minor: None.

GPA: 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 course to be accepted. MSU students should complete the pre-engineering courses listed under the major.

COURSE DESCRIPTIONS

Computer Science

COMS 110 (4) Foundation of Computer Science
This course provides a comprehensive introduction to the foundations of computer science. The topics covered include algorithms, pseudocode, computer theory, computer hardware, computer software, and the related social issues. Lab work develops familiarity with both hardware and software. The course is intended to provide knowledge and skills applicable to all disciplines while providing a broad introduction to the field of computer science.
Pre: MATH 112 (College Algebra)
GE-13

COMS 171 (2) Introduction to C++ Programming
This course provides an introduction to programming using C++. Emphasis on structured programming concepts, with a brief discussion of object-oriented programming. Control structures, expressions, input/ output, arrays, and functions.
F, S

COMS 211 (4) Fundamentals of Computer Science I
This is the first course in a two-course sequence for students who are planning to major or minor in computer science. The course emphasizes concepts needed for continuing study in computer science, the use of abstraction in program design, and advanced problem-solving skills. Programming in a high-level language is a focal point of the course.
Prerequisite: A grade of A or B in COMS 110.
Coreq.: MATH 121 (Calculus I)

COMS 212 (4) Fundamentals of Computer Science II
This course is a continuation of 211. The course introduces students to object-oriented concepts and programming techniques. It also covers essential data structures such as linked lists, stacks, and queues, and trees. The student will be expected to produce larger applications, utilizing multiple compilation units.
Prerequisite: COMS 211

COMS 310 (4) Data Structures & Algorithms
Study of trees, hashing, and graph algorithms. Analysis of algorithms, memory management, and proof techniques.
Pre: COMS 212, MATH 180 or 121 F, S

COMS 320 (4) Machine Structures and Programming
Introduction to computer hardware and its design including Boolean logic, basic digital circuits, number representations and digital arithmetic, instruction set design, digital storage, performance metrics, processor datapath and control, pipelining, memory hierarchy, busses and I/O interfacing, parallel processors.
Pre: COMS 212, MATH 180 or 121 F, S

COMS 380 (4) Systems Analysis & Design
This course explores both structured as well as object oriented systems analysis and design. Use of upper and lower CASE tools are employed in the analysis, design and implementation of a team oriented term project.
Pre: COMS 212 F, S

COMS 460 (4) Operating Systems
This course covers basic operating systems concepts including processes, interprocess communication, interprocess synchronization, deadlock, memory allocation, segmentation, paging, resource allocation, scheduling, performance evaluation, file systems, storage, devices, protection, security, privacy and distributed systems.
Pre: COMS 320 F

COMS 462 (4) Communication Protocols
Advanced coverage of data communication and networking protocols with an emphasis on protocol design and implementation. Topics addressed will include data transmission methods, error detection and recovery, flow control, routing, data throughput, and performance analysis of existing and emerging Internet protocols.
Pre: COMS 362 Variable

Electrical Engineering

EE 101 (1) Introduction to Engineering I
Discussion of historical, educational, and professional aspects of engineering. Problem solving, study approaches and techniques, and the motivation 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.
F

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 S

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 demondulation/detection, bandpass mondulation 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