**Computer Engineering**

*College of Science, Engineering & Technology*

*Department of Electrical and Computer Engineering and Technology*

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Web site: www.cset.mnsu.edu/ecet

Chair: Bill Hudson, Ph.D.

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Computer Engineering (CE) encompasses the research, development, design and operation of computers and computerized systems and their components. This program leads to a Bachelor of Science in Computer Engineering. The primary objective of the Computer Engineering program is to educate engineering professionals who possess sound design and analytical background coupled with a strong laboratory experience supporting Computer Engineering concepts. This means that the department prepares 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.

The educational objectives for our Bachelor of Science in Computer Engineering degree are to prepare our graduates to:

1. Function as responsible members of society with an awareness of the social, ethical, and economic ramifications of their work.
2. Become successful practitioners in engineering and other diverse careers.
3. Succeed in full time graduate and professional studies.
4. Pursue continuing and life-long learning opportunities.
5. Pursue professional registration.
6. Provide foundational education that allows for personal growth and flexibility through their career.

Our metrics for determining success in meeting these objectives will include:

1. Assessment of societal, economic awareness, and ethical performance of our graduates by the graduate and employer.
2. Monitoring of the success of our graduates in the work force.
3. Monitoring of the success of our graduates in graduate and professional programs.
4. Assessment of continuing and life-long learning by the graduate (and their employer as applicable.).
5. Reviewing the number and success of our students completing professional registration to advance their careers.

In support of these objectives, the program provides a curriculum including the following components that will prepare students for excellent careers in Computer Engineering:

1. A strong background in the physical sciences; mathematics, including discrete math; and engineering sciences, including extensive hands-on laboratory instruction.
2. An integrated design component 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 sub-disciplines in the senior level electives.
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. A course in engineering economics to promote awareness of the economic aspects of engineering.
6. Preparation for continuing study and professional development.

During the senior year, as allowed by the state, students will be required to take the Fundamentals of Engineering (FE) examination or its equivalent.

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. 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 56 semester credits including the following:

- General Physics (calculus-based) (10 credits)
- Calculus, Differential Equations, Probability & Statistics (20 credits)
- Electrical Engineering Circuit Analysis I and II (including lab.) (7 credits)
- Chemistry (5 credits)
- English Composition (4 credits)
- Computer Sciences (3 credits)
- Introduction to Electrical and Computer Engineering (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 CS courses at Minnesota State Mankato.
2. have a cumulative GPA of 2.25 on all upper division EE and CS courses, and
3. have completed their senior design sequence at Minnesota State Mankato.
4. have taken the Fundamentals of Engineering (FE) exam or its equivalent and achieved the desired competency level.

Petition to evaluate transfer credits must occur no later than the first semester the student is enrolled in or declared a major housed in the Department of Electrical and Computer Engineering Technology.

**Accreditation.** Computer Engineering is not an accredited program by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

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

COMPUTER ENGINEERING BSEC

Required for Major (Prerequisites, 62 credits):
CHEM 201 General Chemistry I (5)
CS 220 Machine Structures and Programming (3)
EE 106 Intro to EE and CE I (3)
EE 107 Intro to EE and CE II (3)
EE 230 Circuit Analysis I (3)
EE 231 Circuit Analysis II (3)
EE 235 Microprocessor Engineering Lab I (1)
EE 240 Evaluation of Circuits (1)
EE 295 Computer Hardware and Organization (3)
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 180 Mathematics for Computer Science (4)
MATH 223 Calculus III (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 (4)
PHYS 222 General Physics II (3)
PHYS 223 General Physics III (3)

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 ART 260 ART 261 ART 413
ART 416 ART 419 ART 460 ART 462
ART 463 ART 466 ART 469 ENG 112W
ENG 113W ENG 114 ENG 320 ENG 321
ENG 325 ENG 327 ENG 328 ENG 331
ENG 332 ENG 400 ENG 401 ENG 402
ENG 403 ENG 405 ENG 406 ENG 416
ENG 478 ENG 479 ENG 481
FOREIGN LANGUAGE 200 level or above; HIST all except 490 and higher;
HUM 150 HUM 155 HUM 250W* HUM 280W
HUM 281W HUM 282 MASS 110 MASS 411
MASS 412 MUS 120 MUS 125 MUS 126
MUS 220 MUS 321 MUS 322 MUS 422
MUS 423 MUS 424 MUS 425 MUS 426
MUS 429 MUS 432

PHIL all except 490 and higher;
SPEE 203 SPEE 300 SPEE 315 SPEE 403
SPEE 412 SPEE 413 THEA 100 THEA 252
THEA 285W THEA 481 THEA 482
* Note: EET 125 may be substituted for HUM 250W

Social Sciences (6-7 credits)
Courses acceptable by department or program include:
ANTH all courses except 480 and above;
GEOG 100 GEOG 101 GEOG 103 GEOG 340
GEOG 341 GEOG 425 GEOG 430 GEOG 435
GEOG 437 GEOG 445 GEOG 446 GEOG 450
GEOG 454 GEOG 456

PSYC all except
PSYC 201 PSYC 202 PSYC 291 PSYC 303
PSYC 390 PSYC 391 PSYC 473 and above;

SOC all except
SOC 201 SOC 202 SOC 466 SOC 469
SOC 470 SOC 485 and above;

URBS all except
URBS 301 URBS 302 URBS 481 and above;

WOST all except
WOST 260 WOST 277 WOST 290 WOST 320
WOST 430 WOST 460 and above.

In general, graduation credits toward the humanities requirement is not allowed 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.

For a complete listing of approved Humanities and Social Science courses please consult the department web site.

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, 40 credits):
CS 320 Computer Architecture (3)
CS 360 Systems Programming (3)
EE 332 Electronics I (3)
EE 333 Electronics II (3)
EE 334 Microprocessor Engineering (3)
EE 336 Principles of Engineering Design I (1)
EE 337 Principles of Engineering Design II (1)
EE 341 Signals and Systems (3)
EE 342 Electronics Laboratory (1)
EE 344 Design and Evaluation of Microprocessors (1)
EE 350 Engineering Electromagnetics (3)
EE 358 Control Systems (3)
EE 368 Control Systems Lab (1)
EE 381 Digital System Design with Testability (3)
EE 382 Digital System Design with Testability Lab (1)
EE 450 Engineering Economics (3)
EE 467 Principles of Engineering Design III (1)
EE 477 Principles of Engineering Design IV (1)
ME 299 Thermal Analysis (2)

Required Electives
Choose a minimum of 7 credits from the following courses:
EE 453 EE 471 EE 472 EE 475 EE 476
EE 479 EE 480 EE 481 EE 484 EE 487

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. Minnesota State Mankato students should complete the pre-engineering courses listed under the major.

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EE 298 (1-4) Topics
Varied topics in Electrical and Computer Engineering. May be repeated as topics change.
Pre: to be determined by course topic

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
Spring

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.
Fall

EE 332 (3) Electronics I
Introduction to discrete and microelectronics circuits including analog and digital electronics. Device characteristics including diodes, BJTs, JFET's, and MOSFET's will be studied. DC bias circuits, small and large signal SPICE modeling and analysis and amplifier design and analysis will be discussed.
Pre: EE 231

EE 350 (4) Digital Logic Design
Course focuses on design of digital circuitry with emphasis on combinational logic, sequential circuits, and design verification. Topics include logic gates, flip-flops, counters, shift registers, memories, and basic logic design tools. Students will implement a complete digital system using logic design techniques.
Pre: EE 232
Fall

EE 355 (3) Introduction to Computer Systems Architecture
This course presents basic concepts of computer systems architecture and the components that make up modern computer systems. Topics include the x86 architecture, instruction set architecture, assembly language programming, memory system organization, and I/O interfaces. Emphasis is placed on understanding the hardware-software interface of modern computer systems.
Pre: EE 232
Fall

EE 372 (3) Computer Architecture Laboratory
Laboratory support for EE 371. Experiments include the design and implementation of a simple computer system using hardware description languages and simulation tools.
Pre: EE 371
Spring

EE 375 (3) Computer Systems Organization Laboratory
Laboratory support for EE 374. Experiments include the design and implementation of a simple computer system using hardware description languages and simulation tools.
Pre: EE 374
Spring

EE 402 (4) Advanced Computer Architecture
This course covers advanced topics in computer architecture, including superscalar processors, distributed memory systems, and DSM architectures. Emphasis is placed on understanding the design and implementation of modern computer systems.
Pre: EE 355
Fall

EE 403 (3) Introduction to Microprocessors
Course covers the fundamentals of microprocessor design and architecture. Topics include instruction sets, memory organization, and I/O interfaces. Emphasis is placed on understanding the hardware-software interface of modern computer systems.
Pre: EE 232
Fall

EE 424 (4) Computer System Design
This course presents the design and implementation of computer systems. Topics include system architecture, memory management, I/O interfaces, and operating systems. Emphasis is placed on understanding the design and implementation of modern computer systems.
Pre: EE 371 and EE 375
Fall

EE 425 (3) Advanced Computer Systems Design
This course covers advanced topics in computer systems design, including distributed systems, networked systems, and parallel processing. Emphasis is placed on understanding the design and implementation of modern computer systems.
Pre: EE 371 and EE 375
Fall

EE 430 (3) Advanced Computer Engineering: Computer Systems Design
This course presents advanced topics in computer systems design, including distributed systems, networked systems, and parallel processing. Emphasis is placed on understanding the design and implementation of modern computer systems.
Pre: EE 371 and EE 375
Fall

EE 435 (4) Advanced Computer Engineering: Computer Systems Design Laboratory
Laboratory support for EE 434. Experiments include the design and implementation of a simple computer system using hardware description languages and simulation tools.
Pre: EE 434
Spring

EE 444 (3) Computer Engineering Projects
This course provides an opportunity for students to apply their knowledge of computer systems design in a practical project. Students will work in teams to design and implement a computer system.
Pre: EE 371 and EE 375
Fall
EE 333 (3) Electronics II
The second course of the electronics sequence presenting concepts of feedback, oscillators, filters, amplifiers, operational amplifiers, hysteresis, bi-stability, and non-linear functional circuits. MOS and bipolar digital electronic circuits, memory, electronic noise, and power switching devices will be studied.
Pre: EE 332
Spring

EE 334 (3) Microprocessor Engineering II
A more advanced study of microprocessors and microcontrollers in embedded system design. Use of C language in programming, interrupt interfaces such as SPI, I2C, and CAN. External memory design and on-chip program memory protection are also studied.
Pre: EE 234 and EE 295
Fall

EE 336 (1) Principles of Engineering Design I
Electrical and computer engineering project and program management and evaluation techniques will be studied. Emphasis will be placed on the use of appropriate tools for planning, evaluation, and reporting on electrical and computer engineering projects.
Pre: Junior Standing
Fall

EE 337 (1) Principles of Engineering Design II
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: EE 336
Spring

EE 338 (3) Control Systems
Pre: EE 341
Spring

EE 363 (1) Communication Systems Laboratory
Pre: Concurrent with EE 353
Spring

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
Spring

EE 381 (3) Digital System Design with Testability
Practical aspects of digital systems design and hardware testability will be presented in this course. Software tools and theoretical presentations will emphasize necessary concepts of digital design.
Pre: EE 106, CS 220, and EE 295
Fall

EE 382 (1) Digital System Design with Testability Lab
Laboratory support for EE 381. Practical aspects of digital systems design and hardware testability will be presented through laboratory experiences.
Pre: Concurrent with EE 381
Fall

EE 383 (3) Advanced Digital System Design
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 PHIL 222
Variable

EE 439 (3) Electronics for Non-Electrical Engineering Majors
Overview of accounting and finance and their interactions with engineering. Lectures include the development and analysis of financial statements, time value of money, decision making tools, cost of capital, depreciation, project analysis and payback, replacement analysis, and other engineering decision making tools.
Pre: Advanced standing in the program
Fall

EE 450 (3) Engineering Economics
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 EE 363
Fall

EE 453 (3) Advanced Communications Systems Engineering
Design of combinational and sequential systems and peripheral interfaces. Design techniques using MSI and LSI components in an algorithmic state machine; implementation will be stresses. Rigorous timing analysis transmission-line effects and metastability of digital systems will be studied.
Pre: EE 244
EE 467 (1) Principles of Engineering Design III
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
Fall

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 EE 368
Fall

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
Spring

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.
Pre: EE 303 and EE 332
Fall

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 (1) Principles of Engineering Design IV
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 and Senior Standing
Spring

EE 479 (3) Superconductive Devices
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.
Pre: Concurrent with EE 475
Fall

EE 481 (1) VLSI Design Laboratory
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
Spring

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
Fall

EE 483 (4) VLSI Design
Pre: EE 333
Spring

EE 484 (3) RF Systems Engineering
Pre: EE 353 and EE 363
Variable

EE 487 (3) RF Systems Engineering
Pre: EE 353 and EE 363
Variable

EE 488 (2) Thermal Systems Engineering
Pre: PHYS 222 and EE 333
Variable

EE 491 (1-4) In-Service

EE 497 (1-6) Internship

EE 498 (1-4) Topics
Varied topics in Electrical and Computer Engineering. May be repeated as topics change. Prerequisite: to be determined by course topic

EE 499 (1-6) Individual Study

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