Computer Engineering
College of Science, Engineering & Technology
Department of Electrical and Computer Engineering and Technology
137 Trafton Science Center S  507-389-5747
Web site: www.cset.mnsu.edu/ecet

Chair: Bill Hudson, Ph.D.
Program Coordinator: Julio Mandojana, Ph.D.

Gale Allen, Ph.D.; Mark Dvorak, Ph.D.; Tom Hendrickson, Ph.D.; Han-Way Huang, Ph.D.; Bill Hudson, Ph.D.; Rajiv Kapadia, Ph.D.; Muhammad Khaliq, Ph.D.; Paul Lindfors, Ph.D.; Julio Mandojana, Ph.D.; Ramakrishna Nair, Ph.D.; Vincent Winstead, Ph.D.; Qun Zhang, Ph.D.

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 (Java and C++) (4 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.

P/N Grading Policy. A student who majors in CE must elect the grade option for
Courses acceptable by department or program include:

**Humanities (6-7 credits)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>ART 416</td>
<td>2</td>
<td>Engineering Analysis (3)</td>
</tr>
<tr>
<td>ART 421</td>
<td>3</td>
<td>Engineering Analysis (3)</td>
</tr>
<tr>
<td>ENG 271</td>
<td>3</td>
<td>Technical Communication (4) OR</td>
</tr>
<tr>
<td>SPEE 233</td>
<td>3</td>
<td>Public Speaking for Technical Professionals (3) OR</td>
</tr>
<tr>
<td>SPEE 102</td>
<td>3</td>
<td>Public Speaking (3)</td>
</tr>
<tr>
<td>MATH 121</td>
<td>4</td>
<td>Calculus I (4)</td>
</tr>
<tr>
<td>MATH 122</td>
<td>4</td>
<td>Calculus II (4)</td>
</tr>
<tr>
<td>MATH 180</td>
<td>4</td>
<td>Mathematics for Computer Science (4)</td>
</tr>
<tr>
<td>MATH 223</td>
<td>3</td>
<td>Calculus III (4)</td>
</tr>
<tr>
<td>MATH 321</td>
<td>3</td>
<td>Ordinary Differential Equations (4)</td>
</tr>
<tr>
<td>MATH 355</td>
<td>3</td>
<td>Concepts of Probability and Statistics (3) OR</td>
</tr>
<tr>
<td>ME 291</td>
<td>3</td>
<td>Engineering Analysis (3)</td>
</tr>
<tr>
<td>PHYS 221</td>
<td>3</td>
<td>General Physics I (5)</td>
</tr>
<tr>
<td>PHYS 222</td>
<td>3</td>
<td>General Physics II (5)</td>
</tr>
</tbody>
</table>

**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:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Department</th>
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</thead>
<tbody>
<tr>
<td>ART 160</td>
<td>3</td>
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</tr>
<tr>
<td>ART 416</td>
<td>3</td>
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<tr>
<td>ART 463</td>
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</tr>
<tr>
<td>ENG 113W</td>
<td>4</td>
<td>Ordinary Differential Equations (4)</td>
</tr>
<tr>
<td>ENG 332</td>
<td>3</td>
<td>Calculus IV (4)</td>
</tr>
<tr>
<td>ENG 403</td>
<td>3</td>
<td>Calculus V (4)</td>
</tr>
<tr>
<td>ENG 478</td>
<td>3</td>
<td>Calculus VI (4)</td>
</tr>
</tbody>
</table>

**FOREIGN LANGUAGE 200 level or above; HIST all except 400 and higher;**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>HUM 150</td>
<td>3</td>
<td>Calculus I (4)</td>
</tr>
<tr>
<td>HUM 281W</td>
<td>3</td>
<td>Calculus II (4)</td>
</tr>
<tr>
<td>MASS 412</td>
<td>3</td>
<td>Calculus III (4)</td>
</tr>
<tr>
<td>MUS 220</td>
<td>3</td>
<td>Ordinary Differential Equations (4)</td>
</tr>
<tr>
<td>MUS 423</td>
<td>3</td>
<td>Calculus IV (4)</td>
</tr>
<tr>
<td>MUS 429</td>
<td>3</td>
<td>Calculus V (4)</td>
</tr>
</tbody>
</table>

**PHIL all except 400 and higher;**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPEE 203</td>
<td>3</td>
<td>Public Speaking (3)</td>
</tr>
<tr>
<td>SPEE 300</td>
<td>3</td>
<td>Public Speaking for Technical Professionals (3) OR</td>
</tr>
<tr>
<td>SPEE 315</td>
<td>3</td>
<td>Public Speaking for Technical Professionals (3) OR</td>
</tr>
<tr>
<td>THEA 285W</td>
<td>3</td>
<td>Public Speaking for Technical Professionals (3) OR</td>
</tr>
<tr>
<td>THEA 481</td>
<td>3</td>
<td>Public Speaking for Technical Professionals (3) OR</td>
</tr>
</tbody>
</table>

* Note: EET 125 may be substituted for HUM 250W

**Social Sciences (6-7 credits)**

Courses acceptable by department or program include:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTH all courses except 480 and above;</td>
<td></td>
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</tr>
<tr>
<td>GEOG 100</td>
<td>3</td>
<td>Calculus I (4)</td>
</tr>
<tr>
<td>GEOG 101</td>
<td>3</td>
<td>Calculus II (4)</td>
</tr>
<tr>
<td>GEOG 341</td>
<td>3</td>
<td>Calculus III (4)</td>
</tr>
<tr>
<td>GEOG 437</td>
<td>3</td>
<td>Calculus IV (4)</td>
</tr>
<tr>
<td>GEOG 454</td>
<td>3</td>
<td>Calculus V (4)</td>
</tr>
<tr>
<td>POL all except:</td>
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<td></td>
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<tr>
<td>POL 420</td>
<td>3</td>
<td>Calculus I (4)</td>
</tr>
<tr>
<td>POL 421</td>
<td>3</td>
<td>Calculus II (4)</td>
</tr>
<tr>
<td>POL 422</td>
<td>3</td>
<td>Calculus III (4)</td>
</tr>
<tr>
<td>POL 490 and above;</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Department</th>
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<tbody>
<tr>
<td>PSYC all except</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSYC 201</td>
<td>3</td>
<td>Calculus I (4)</td>
</tr>
<tr>
<td>PSYC 390</td>
<td>3</td>
<td>Calculus II (4)</td>
</tr>
<tr>
<td>PSYC 473</td>
<td>3</td>
<td>Calculus III (4)</td>
</tr>
<tr>
<td>SOC all except</td>
<td></td>
<td></td>
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<tr>
<td>SOC 201</td>
<td>3</td>
<td>Calculus I (4)</td>
</tr>
<tr>
<td>SOC 302</td>
<td>3</td>
<td>Calculus II (4)</td>
</tr>
<tr>
<td>SOC 466</td>
<td>3</td>
<td>Calculus III (4)</td>
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<tr>
<td>WOST all except</td>
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</tr>
<tr>
<td>WOST 260</td>
<td>3</td>
<td>Calculus I (4)</td>
</tr>
<tr>
<td>WOST 277</td>
<td>3</td>
<td>Calculus II (4)</td>
</tr>
<tr>
<td>WOST 430</td>
<td>3</td>
<td>Calculus III (4)</td>
</tr>
</tbody>
</table>

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):**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 320</td>
<td>3</td>
<td>Computer Architecture (3)</td>
</tr>
<tr>
<td>CS 360</td>
<td>3</td>
<td>Systems Programming (3)</td>
</tr>
<tr>
<td>EE 332</td>
<td>3</td>
<td>Electronics I (3)</td>
</tr>
<tr>
<td>EE 333</td>
<td>3</td>
<td>Electronics II (3)</td>
</tr>
<tr>
<td>EE 334</td>
<td>3</td>
<td>Microprocessor Engineering (3)</td>
</tr>
<tr>
<td>EE 336</td>
<td>3</td>
<td>Principles of Engineering Design I (1)</td>
</tr>
<tr>
<td>EE 337</td>
<td>3</td>
<td>Principles of Engineering Design II (1)</td>
</tr>
<tr>
<td>EE 341</td>
<td>3</td>
<td>Signals and Systems (3)</td>
</tr>
<tr>
<td>EE 342</td>
<td>3</td>
<td>Electronics Laboratory (1)</td>
</tr>
<tr>
<td>EE 344</td>
<td>3</td>
<td>Design and Evaluation of Microprocessors (1)</td>
</tr>
<tr>
<td>EE 350</td>
<td>3</td>
<td>Engineering Electromagnetics (3)</td>
</tr>
<tr>
<td>EE 358</td>
<td>3</td>
<td>Control Systems (3)</td>
</tr>
<tr>
<td>EE 368</td>
<td>3</td>
<td>Control Systems Lab (1)</td>
</tr>
<tr>
<td>EE 381</td>
<td>3</td>
<td>Digital System Design with Testability (3)</td>
</tr>
<tr>
<td>EE 382</td>
<td>3</td>
<td>Digital System Design with Testability Lab (1)</td>
</tr>
<tr>
<td>EE 450</td>
<td>3</td>
<td>Engineering Economics (3)</td>
</tr>
<tr>
<td>EE 467</td>
<td>3</td>
<td>Principles of Engineering Design III (1)</td>
</tr>
<tr>
<td>EE 477</td>
<td>3</td>
<td>Principles of Engineering Design IV (1)</td>
</tr>
<tr>
<td>EE 299</td>
<td>3</td>
<td>Thermal Analysis (2)</td>
</tr>
</tbody>
</table>

**Required Electives**

Choose a minimum of 7 credits from the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 453</td>
<td>3</td>
<td>Control Systems Lab (1)</td>
</tr>
<tr>
<td>EE 457</td>
<td>3</td>
<td>Control Systems Lab (1)</td>
</tr>
<tr>
<td>EE 475</td>
<td>3</td>
<td>Control Systems Lab (1)</td>
</tr>
<tr>
<td>EE 476</td>
<td>3</td>
<td>Control Systems Lab (1)</td>
</tr>
<tr>
<td>EE 479</td>
<td>3</td>
<td>Control Systems Lab (1)</td>
</tr>
</tbody>
</table>

**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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**COURSE DESCRIPTIONS**

**Computer Science**

**CS 220 (3) Machine Structures and Programming**

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2007-2008 Undergraduate Bulletin
This course introduces students to assembly language programming and basic
machine structures. Topics include number systems, basic central processing unit
(CPU) organization, instruction formats, addressing modes and their use with a
variety of data structures; and parameter passing techniques.
Prerequisite: CS 110 and EE 106
Fall, Spring

CS 320 (3) Computer Architecture
This course presents historical and current concepts and implementations of
computer organization. Topics include instruction set design, digital storage,
performance metrics, processor datapath and control, pipelining, memory hier-
archy, busses and I/O interfacing, and parallel processors.
Prerequisite: CS 111 and CS 220, or EE 234 and EE 334
Spring

CS 360 (3) Systems Programming
This course focuses on machine level I/O and operating system file processing.
Structure of systems programs including assemblers, linkers, and object-oriented
utilities and interfaces. Students will gain experience in writing utility programs
and extensions to an operating system.
Prerequisite: CS 111 or EE 107, and CS 320
Fall

Electrical Engineering

EE 106 (3) Introduction to Electrical/Computer Engineering I
This introductory course covers digital systems topics including binary numbers,
logic gates, Boolean algebra, circuit simplification using Karnaugh maps, flip-
flops, counters, shift registers and arithmetic circuits. Problem solving methods,
study skills and professional development will be addressed throughout the course.
Prerequisite: MATH 112
Fall, Spring

EE 107 (3) Introduction to Electrical/Computer Engineering II
The course presents algorithmic approaches to problem solving and computer
program design using the C language. Students will explore Boolean expressions,
implement programs using control structures, modular code and file input/output,
and interface with external hardware using robots and sensors.
Prerequisite: EE 106
Spring

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
Prerequisites: PHYS 222 or concurrent, MATH 321 or concurrent
Fall

EE 231 (3) Circuit Analysis II
Continuation of Circuit Analysis I to include special topics in circuit analysis.
Prerequisites: EE 230 and EE 240, MATH 321, PHYS 222
Spring

EE 235 (1) Microprocessor Engineering Laboratory I
Laboratory support for EE 234. Use of development boards and assembly
language programming to handle interrupts, interface with parallel I/O ports,
memory, and timers. Experiments will involve signal and frequency measure-
ments, data conversions, and interface design.
Prerequisite: EE 106, EE 107, CS 200 and EE 235 taken concurrently

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
and AC circuits using SPICE. Concepts covered in EE 230 will be verified
in the laboratory.
Prerequisite: Must be taken concurrently with EE 230.
Fall

EE 244 (2) Introduction to Digital Systems
Simple coding schemes, Boolean algebra fundamentals, elements of digital
building blocks such as gates, flip-flops, shift registers, memories, etc.; basic
engineering aspects of computer architecture.

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. Ex-
perimental evaluation of digital logic devices and circuits including logic gates,
flip-flops, and sequential machines.
Prerequisite: EE 230 and concurrent with EE 244.
Spring

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.
Prerequisite: EE 230, EE 240 and concurrently with EE 231 and EE 244
Spring

EE 295 (3) Computer Hardware and Organization
This course introduces the computer engineering fundamentals on which cur-
rent computer systems are based and includes Boolean algebra and simple logic
circuits that describe the hardware of modern computer systems. Students gain
a deeper understanding of computers by building and microprogramming their
own machine.
Prerequisite: CS 220 and EE 235
Spring

EE 298 (1-4) Topics
Varied topics in Electrical and Computer Engineering. May be repeated as
topics change.
Prerequisite: 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, recombina-
tion. Analysis and design of PN-junctions, (bipolar transistor, junction) and
MOS field-effect transistors. Introduction to transferred electron devices and
semiconductor diode laser.
Prerequisites: PHYS 222, and MATH 321
Fall

EE 304 (1) Lab: Introduction to Solid State Devices
Laboratory support for EE 303. Experiments include resistivity and sheet re-
stance 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 ofMOS 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 model-
ing and analysis and amplifier design and analysis will be discussed.
Prerequisite: EE 231

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.
Prerequisite: EE 332
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 341 (3) 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: EE 230, MATH 321 and PHYS 222
Fall

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 EE 332 taken concurrently.
Fall

EE 344 (1) Design & Evaluation of Microprocessors
Laboratory support for EE 334. Use of development boards and C Programming language to handle I/O devices, interrupts, and all peripheral functions. Multiple functions such as timers, A/D converters, I/O devices, interrupts, and serial modules will be used together to perform desired operations.
Pre: Concurrent with EE 334
Fall

EE 350 (3) Engineering Electromagnetics
Pre: EE 231, MATH 223, MATH 321 and PHYS 222
Spring

EE 353 (3) Communications Systems Engineering
Pre: EE 341, MATH 223
Spring

EE 358 (3) Control Systems
Pre: EE 341

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 442 (1) Electronics Laboratory
Pre: EE 230. MATH 321 and PHYS 222

EE 450 (3) Engineering Economics
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

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/detector, 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 463 (3) Advanced Digital System Design
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.
Prerequisite: 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.
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 473 (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 484 (3) VLSI Design
Pre: EE 333
Spring

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