Department of Electrical and Computer Engineering

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Degrees offered: Bachelor of Science (BS), Master of Science (MS), and Doctor of Philosophy (PhD) in Electrical Engineering; BS and MS in Computer Engineering; Master of Engineering (ME)

Graduate specializations: *ME*—Electrical Engineering, Computer Engineering

Undergraduate Programs

Department Mission Statement

The mission of the Department of Electrical and Computer Engineering is to serve society through excellence in learning, discovery, and outreach. Undergraduate and graduate students are provided with an education in electrical and computer engineering, while developing attitudes, values, and vision preparing them for lifetimes of continued learning and leadership in their chosen careers. Through research the department strives to generate and disseminate new knowledge and technology for the benefit of the State of Utah, the nation, and beyond.

Program Description

The ECE Department offers a balanced curriculum of classwork, laboratory work, and design experiences to prepare students for careers as practicing engineers. The Bachelor of Science programs in Electrical Engineering and Computer Engineering are accredited by the Engineering Accreditation Commission of ABET. The research program of the department, which includes undergraduates as well as graduate students, is internationally acclaimed in the fields of aerospace instrumentation and measurements, image compression, communications, electromagnetics, controls, and robotics.

Program Objectives

The educational objectives of the Electrical Engineeering and Computer Engineering programs at Utah State University are as follows:

To provide students with:

1. Education in the fundamental sciences and mathematics that underlie engineering, with a general breadth and depth in engineering analysis and design.

2. Awareness of current technology and the fundamental background to enable them to stay informed and become adept at new technologies.

3. The ability to put ideas into practice through effective analysis, problem solving, requirements development, design, and implementation.

4. A broad awareness of the world around them through general education, preparing them to achieve their potential and contribute through their professional and personal lives.

5. The foundation of communications and teamwork skills, as well as professional attitudes and ethics.

Electrical Engineering

Each Electrical Engineering student is given a solid foundation in electricity, electronics, signals, and systems, with individual practical experience. Upon this basic foundation, the students then build expertise in advanced areas, stressing actual design practice, to prepare them for productive engineering careers. The focus areas can be categorized into the following: analog and digital electronics, controls, signal processing, communications, electromagnetics, microwaves, and space systems.

Computer Engineering

Building on a solid curriculum in computing hardware and software, the Computer Engineering program begins with a strong foundation in electricity, digital logic design, and computer science, then leads into advanced software engineering and microcomputer systems. Advanced courses provide experience in formal design methods, high-performance architectures, data communications, concurrent programming, and real-time and embedded systems. Students are also required to complete advanced course sequences in computer science.

Students in the BS programs in both electrical engineering and computer engineering are permitted and encouraged to take courses in the other program. Many courses, such as controls, digital signal processing, and robotics, draw heavily on skills in both areas.

Assessment

In addition to the regular national accreditation, the ECE Department employs a number of means to assess the quality of departmental programs. The primary indicator is the success of ECE graduates in obtaining professional employment. At intervals following graduation, the department keeps track of student placement. Other major tools include annual quantitative assessment of program objectives, semi-annual reviews of the curriculum and facilities by the ECE Industrial Advisory Board, interviews of undergraduate and graduate students upon completion of their programs, regular monitoring of faculty members by peers, and surveys of ECE graduates working in industry.

Requirements

Prior to entry into the upper-division classes, the student must meet the standards for entry into the Professional Engineering Program. Additional information concerning these items is given in the College of Engineering write-up (pages 122-123). It is the responsibility of students to be aware of these rules and procedures; however, advisor assistance is available.

Department of Electrical and Computer Engineering

Admission to Pre-Professional Program

Admission requirements for students desiring to major in Electrical Engineering or Computer Engineering are the same as those governing admission to the College of Engineering (see page 121), *except* that students must also be "calculus ready." That is, they must: (1) achieve a score of 27 or higher on the math ACT test; (2) complete MATH 1050 and 1060 *or* MATH 1210; or (3) achieve an AP score of at least 3 on the AB Calculus or BC Calculus test.

Bachelor of Science in Electrical Engineering

The program leading to a Bachelor of Science degree in electrical engineering is nominally a four-year program. The required program consists of a basic foundation of mathematics, science, computer science, engineering fundamentals, and laboratory and design experiences. Elective courses providing for one or more areas of technical focus, communication skills, and University Studies complete the program and prepare students for productive and rewarding careers in the electrical engineering profession.

Bachelor of Science in Computer Engineering

The program leading to a Bachelor of Science in computer engineering is nominally a four-year program. The required program consists of a basic foundation of mathematics, science, computer science, engineering fundamentals, and laboratory and design experiences. Elective courses providing for one or more areas of technical focus, communication skills, and University Studies complete the program and prepare students for productive and rewarding careers in the computer engineering profession.

Required Courses

Required courses are shown in the accompanying paragraphs; however, because of differences in high school or transfer student preparation, it is strongly recommended that students meet with the college academic advisor to plan a detailed semester-by-semester schedule for completing the preprofessional requirements. Particular attention must be paid to course prerequisites, requiring some students to take longer than four semesters to complete the preprofessional program. Students transferring into the department should consult with the college academic advisor for transfer credit evaluation and proper placement in the curriculum.

AP and CLEP credit may be used to meet some of the required technical and University Studies courses. Details concerning courses acceptable as electives are available from the Electrical and Computer Engineering Department.

Electrical Engineering

Pre-professional Program

Suggested Semester Schedule (126 credits)

Freshman Year (30 credits)

Fall Semester (15 credits)

MATH 1210 (QL)* Calculus I 4
CS 1400* Introduction to Computer Science—CS 1 3
ECE 1000* Introduction to Electrical and Computer Engineering 2
University Studies Breadth courses 6

Spring Semester (15 credits)

MATH 1220 (QL)* Calculus II 4
CS 1410 (QI)* Introduction to Computer Science—CS 2 3
PHYS 2210 (QI)* General Physics—Science and Engineering I 4
ECE 2700* Digital Circuits 4

Sophomore Year (33 credits)

Fall Semester (16 credits)

MATH 2210 (QI)* Multivariable Calculus 3
PHYS 2220 (BPS/QI)* General Physics—Science and Engineering II 4
University Studies Breadth courses 9

Spring Semester (17 credits)

MATH 2250 (QI)* Linear Algebra and Differential Equations 4
ECE 2250* Electrical Circuits 4
ENGL 2010 (CL2)* Intermediate Writing: Research Writing in a Persuasive Mode 3
Technical Elective course 3
University Studies Depth Social Sciences (DSS) course 3

*These classes are required for admission to the Professional Engineering Program (PEP). Courses are listed under the semesters in which they best fit.

Professional Program

Because of the variations in schedules, it is recommended that students meet with an advisor to work out a schedule for their junior and senior years. The following courses are required for students selecting the **Professional Program in Electrical Engineering**.

Suggested Semester Schedule

Junior Year (31credits)[1]

Fall Semester (16 credits)

ECE 3620 Circuits and Signals 3
ECE 3710 Microcomputer Hardware and Software 4
ECE 5530 Digital System Design 3
MATH 5710 Introduction to Probability 3
Technical elective course 3

Spring Semester (15 credits)

ECE 3410 Microelectronics I 4
ECE 3640 Signals and Systems 3
ECE 3820 (CI) Design I 2
ECE 3870 Electromagnetics I 3
Math/Science elective course 3

Senior Year (31-32 credits)

Fall Semester (15 credits)

ECE 4840 (CI) Design II 3
Technical elective course 3
ECE elective courses 9

Spring Semester (16-17 credits)

ECE 4850 (CI) Design III 2
ECE Elective Courses 12
University Studies Depth Humanities and Creative Arts (DHA) course 2-3

[1]Some of the junior classes can be delayed until the senior year, but this may limit a student's choice of electives during his or her senior year.

Technical Elective Courses (select 33 or more credits)

Electrical Engineering Electives (select 21-30 credits)

ECE 3720 Microcomputer Systems Programming (Sp) 3
ECE 4650[4] Optics I (F) 3
ECE 4680[4] Optics II (Sp) 3
ECE 4740 Computer and Data Communications (F) 3

Also, any ECE 5000-level course (including ECE 5930 when topic relates to electrical engineering) may be counted as an Electrical Engineering Elective.

Math and Science Electives (select 3-12 credits)
MATH 3310 Discrete Mathematics (F,Sp,Su) 3
MATH 4200 (CI) Foundations of Analysis (F,Sp) 3
MATH 4310 (CI) Introduction to Algebraic Structures (F,Sp) 3
MATH 5210 Introduction to Analysis I (F) 3
MATH 5220 Introduction to Analysis II (Sp) 3
MATH 5270 Complex Variables (Sp) 3
MATH 5310 Introduction to Modern Algebra (Sp) 3
MATH 5340 Theory of Linear Algebra (Sp) 3
MATH 5420 Partial Differential Equations (Sp) 3
MATH 5460 Introduction to the Theory and Application of Nonlinear Dynamical Systems (Sp) 3
MATH 5510 Introduction to Topology (F) 3
MATH 5610 Computational Linear Algebra and Solution of Systems of Equations (F) 3
MATH 5620 Numerical Solution of Differential Equations (Sp) 3
MATH 5720 Introduction to Mathematical Statistics (Sp) 3
MATH 5760 Stochastic Processes (F) 3
AP Biology 4
BIOL 1610 Biology I (F) 4
BIOL 2420 Human Physiology (F,Sp,Su) 4
BIOL 3300 General Microbiology (F,Sp) 4
AP Chemistry 8
CHEM 1210 Principles of Chemistry I (F,Sp) 4
CHEM 1215 Chemical Principles Laboratory I (F,Sp) 1
CHEM 1220 (BPS) Principles of Chemistry II (F,Sp,Su) 4
CHEM 2310 Organic Chemistry I (F) 4
CHEM 3700 Introductory Biochemistry (Sp) 3
CHEM 3710 Introductory Biochemistry Laboratory (Sp) 1
PHYS 2710 Introductory Modern Physics 3
PHYS 3550[2] Intermediate Classical Mechanics 3
PHYS 3600 Intermediate Electromagnetism 3
PHYS 3700[3] Thermal Physics 3
PHYS 3750 Foundations of Wave Phenomena 3
PHYS 4550 Advanced Classical Mechanics 3
PHYS 4600 Advanced Electromagnetism 3
PHYS 4650 Optics I 3
PHYS 4680 Optics II 3
PHYS 4700 Quantum Mechanics I 3
PHYS 4710 Quantum Mechanics II 3
WILD 2200 (BLS) Ecology of Our Changing World (F,Sp) 3

Technical Electives (select 0-9 credits)
CS 2420 (QI) Algorithms and Data Structures—CS 3 (F,Sp,Su) 3
CS 2450 (CI) Software Engineering (F,Sp) 3
CS 2810 Computer Organization and Architecture (F,Sp) 3
CS 3100 Operating Systems and Concurrency (F,Sp) 3
CS 4700 Programming Languages (F,Sp) 3
CS 5000 Theory of Computability (Sp) 3
CS 5050 Advanced Algorithms (F,Sp) 3
CS 5100 Graphical User Interfaces and Windows Programming (Sp) .. 4
CS 5200 Distributed and Network Programming (F) 4
CS 5300 Compiler Construction (F) 4
CS 5370 Advanced Software Engineering (F) 3
CS 5400 Computer Graphics I (F) 4
CS 5450 Multimedia Systems (Sp) 4
CS 5500 Parallel Algorithms (Sp) 3
CS 5600 AI: Problem Solving and Expert Systems (F) 3
CS 5650 CVPRIP I: Computer Vision, Pattern Recognition, and Image Processing (F) 3
CS 5700 Object-Oriented Software Development (F) 3
CS 5800 Introduction to Database Systems (F) 3
CS 5850 Systems Analysis (Sp) 3
CEE 4200 Engineering Economics (F) 2
ECE 3260 (QI) Science of Sound (F) 3
ECE 4250 Internship/Co-op (F,Sp,Su) 3
ENGR 2010[2] Engineering Mechanics Statics (F,Sp) 2
ENGR 2030 Engineering Mechanics Dynamics (F,Sp) 3
ENGR 2140 Strength of Materials (F,Sp) 2
ENGR 5500 High Performance Computing for Engineers (F) 3
MAE 2160 Material Science (F,Sp) 3
MAE 2300[3] Thermodynamics I (Sp,Su) 3

[2]Students cannot receive credit for both Engineering Mechanics *and* Analytical Mechanics.
[3]Students cannot receive credit for both Engineering Thermodynamics *and* Thermal Physics.
[4]Students cannot receive credit for both ECE Optics *and* PHYS Optics.

Computer Engineering

Pre-professional Program

Suggested Semester Schedule

Freshman Year (30-31 credits)

Fall Semester (15-16 credits)
MATH 1210 (QL)** Calculus I 4
CS 1400** Introduction to Computer Science—CS 1 3
CS 1405[5] Introduction to Computer Science—CS 1 Lab ..... (1)
ECE 1000** Introduction to Electrical and Computer Engineering 2
University Studies Breadth courses 6

Spring Semester (15 credits)
MATH 1220 (QL)** Calculus II 4
CS 1410 (QI)** Introduction to Computer Science—CS 2 3
PHYS 2210 (QI)** General Physics—Science and Engineering I 4
ECE 2700** Digital Circuits 4

Sophomore Year (34-35 credits)

Fall Semester (17 credits)
ENGL 2010 (CL2)** Intermediate Writing: Research Writing in a Persuasive Mode 3
CS 2420 (QI)** Algorithms and Data Structures—CS 3 3
MATH 2250 (QI)** Linear Algebra and Differential Equations 4
PHYS 2220 (BPS/QI)** General Physics—Science and Engineering II 4
University Studies Breadth course 3

Spring Semester (17-18 credits)
MATH 3310 Discrete Mathematics 3
ECE 2250** Electrical Circuits 4
CS 2450 (CI) Software Engineering 3
Technical Elective course 4-5
University Studies Breadth course 3

[5]Students desiring a Computer Science minor must take CS 1405 as a freshman. The rest of the minor is built into the curriculum. This lab is *not required* for the Computer Engineering major.
**These classes are required for admission to the Professional Engineering Program (PEP). Courses are listed under the semesters in which they best fit.

Professional Program

Suggested Semester Schedule

Because of the variation in schedules, it is recommended that students meet with an advisor to work out a schedule for their junior and senior years. The following courses are required for students selecting the **Professional Program in Computer Engineering**.

Suggested Semester Schedule
Junior Year (31 credits)[6]

Fall Semester (16 credits)
CS 3100 Operating Systems and Concurrency 3
ECE 3620 Circuits and Signals 3
ECE 3710 Microcomputer Hardware and Software 4
ECE 5530 Digital System Design 3
University Studies Breadth course 3

Spring Semester (15 credits)
ECE 3410 Microelectronics I 4
ECE 3640 Signals and Systems 3
ECE 3720 Microcomputer Systems Programming 3
ECE 3820 (CI) Design I 2
MATH 5710 Introduction to Probability 3

Senior Year (30-31 credits)

Fall Semester (15-16 credits)
ECE 4740 Computer and Data Communications 3
ECE 4840 (CI) Design II 3
Computer Science elective course 4
Computer Engineering elective course 3
University Studies Depth Humanities and Creative Arts (DHA) course 2-3

Spring Semester (15 credits)
ECE 4850 (CI) Design III 2
High-Level Technical Elective courses 7
Math/Science elective course 3
University Studies Depth Social Sciences (DSS) course 3

[6]Some of the junior classes can be delayed until the senior year, but this may limit a student's choice of electives during his or her senior year.

High-Level Technical Elective Courses (select 14-19 credits)

Students must complete a total of *at least* 14 credits within high-level technical electives. Courses listed in this departmental section as Computer Engineering Electives *or* Computer Science Electives may be used to fulfill this requirement. Also, courses having an ECE *or* CS prefix, which are numbered at the 5000 level, may be used as high-level technical electives.

Technical Elective Courses (select 23 or more credits)

Computer Engineering Electives (select 3-16 credits)
ECE 5320 Mechatronics (Sp) 4
ECE 5640 Real-Time Processors (Sp) 4
ECE 5740 Concurrent Programming (F) 3
ECE 5750 High-Performance Microprocessor Architecture (Sp) 3
ECE 5770 Microcomputer Interfacing (Sp) 4
ECE 5780 Real-Time Systems (F) 4

Computer Science Electives (select 4-13 credits)
CS 5100 Graphical User Interfaces and Windows Programming (Sp) .. 4
CS 5200 Distributed and Network Programming (F) 4
CS 5400 Computer Graphics I (F) 4

Math and Science Electives (select 3-9 credits)
MATH 2210 (QI) Multivariable Calculus (F,Sp,Su) 3
MATH 4200 (CI) Foundations of Analysis (F,Sp) 3
MATH 4310 (CI) Introduction to Algebraic Structures (F,Sp) 3
MATH 5210 Introduction to Analysis I (F) 3
MATH 5220 Introduction to Analysis II (Sp) 3
MATH 5270 Complex Variables (Sp) 3
MATH 5310 Introduction to Modern Algebra (Sp) 3
MATH 5340 Theory of Linear Algebra (Sp) 3
MATH 5420 Partial Differential Equations (Sp) 3
MATH 5460 Introduction to the Theory and Application of Nonlinear Dynamical Systems (Sp) 3
MATH 5510 Introduction to Topology (F) 3
MATH 5610 Computational Linear Algebra and Solution of Systems of Equations (F) 3
MATH 5620 Numerical Solution of Differential Equations (Sp) 3
MATH 5720 Introduction to Mathematical Statistics (Sp) 3
MATH 5760 Stochastic Processes (F) 3
AP Biology 4
BIOL 1610 Biology I (F) 4
BIOL 2420 Human Physiology (F,Sp,Su) 4
BIOL 3300 General Microbiology (F,Sp) 4
AP Chemistry 8
CHEM 1210 Principles of Chemistry I (F,Sp) 4
CHEM 1215 Chemical Principles Laboratory I (F,Sp) 1
CHEM 1220 (BPS) Principles of Chemistry II (F,Sp,Su) 4
CHEM 2310 Organic Chemistry I (F) 4
CHEM 3700 Introductory Biochemistry (Sp) 3
CHEM 3710 Introductory Biochemistry Laboratory (Sp) 1
PHYS 2710 Introductory Modern Physics 3
PHYS 3550[7] Intermediate Classical Mechanics 3
PHYS 3600 Intermediate Electromagnetism 3
PHYS 3700[8] Thermal Physics 3
PHYS 3750 Foundations of Wave Phenomena 3
PHYS 4550 Advanced Classical Mechanics 3
PHYS 4600 Advanced Electromagnetism 3
PHYS 4650[9] Optics I 3
PHYS 4680[9] Optics II 3
PHYS 4700 Quantum Mechanics I 3
PHYS 4710 Quantum Mechanics II 3
WILD 2200 (BLS) Ecology of Our Changing World (F,Sp) 3

Technical Electives (select 0-7 credits)
CS 2810 Computer Organization and Architecture (F,Sp) 3
CS 4700 Programming Languages (F,Sp) 3
CEE 4200 Engineering Economics (F) 2
ECE 4250 Internship/Co-op (F,Sp,Su) 3
ENGR 2010 Engineering Mechanics Statics (F,Sp) 2
ENGR 2030 Engineering Mechanics Dynamics (F,Sp) 3
ENGR 2140 Strength of Materials (F,Sp) 2
MAE 2160 Material Science (F,Sp) 3
MAE 2300 Thermodynamics I (Sp,Su) 3
ENGR 5500 High Performance Computing for Engineers (F) 3

Any upper-division (3000, 4000, or 5000 level) ECE class not required by the major may also be used as a Technical Elective course. However, specific courses must be approved in writing before the student registers for the course.

[7]Students cannot receive credit for both Engineering Mechanics *and* Physics Mechanics.
[8]Students cannot receive credit for both Engineering Thermodynamics *and* Physics Thermodynamics.
[9]Students cannot receive credit for both ECE Optics *and* PHYS Optics.

Minors

Students should have all minors approved by the minor department. Minors may be filled by using the Technical Electives credits for courses in the chosen minor area. All courses required for the minors must be completed with grades of *C-* or better.

Mathematics Minor

Required courses include:
MATH 1210 (QL) Calculus I (F,Sp,Su) 4
MATH 1220 (QL) Calculus II (F,Sp,Su) 4
MATH 2210 (QI) Multivariable Calculus (F,Sp,Su) 3
MATH 2270 (QI) Linear Algebra (F) 3
MATH 2280 (QI) Ordinary Differential Equations (Sp) 3
Two additional courses (6 credits) numbered above 4000, excluding MATH 4300, 4400, 4500, 4620, 5570, and 5580, are also required. MATH 2250 may substitute for MATH 2270 and 2280.

Physics Minor

PHYS 2210 (QI) General Physics–Science and Engineering I 4
PHYS 2220 (BPS/QI) General Physics–Science and Engineering II....4
Students must also select 10 credits from courses in Physics numbered 2710 or above.

Computer Science Minor

A minimum of 16 credits (with a cumulative GPA of 2.5 or higher and a *C-* or better in each class) is required. Students must complete the following courses:
CS 1400 Introduction to Computer Science—CS 1 (F,Sp,Su) 3
CS 1405 Introduction to Computer Science—CS 1 Lab (F,Sp,Su) 1
CS 1410 (QI) Introduction to Computer Science—CS 2 (F,Sp,Su) 3
CS 2420 (QI) Algorithms and Data Structures—CS 3 (F,Sp,Su).....3
Students must also complete two additional computer science classes. One of these two classes must be numbered at the 3000 level or above. Students should contact the Computer Science Department for information about classes that may not be used toward the Computer Science Minor.

Other minors should be approved by the minor department.

Student Research Opportunities

Undergraduate students are extensively involved with research activities in the department. Electrical engineering majors and computer engineering majors have presented papers at research conferences and have won prizes. They have also designed satellites for deployment from the space shuttle. Electrical and Computer Engineering faculty members are dedicated to helping students and providing a challenging and interesting learning atmosphere. For additional information, see the *Research* section under *Graduate Programs* (page 258).

Departmental Honors

Students who would like to experience greater academic depth within their major are encouraged to enroll in departmental honors. Through original, independent work, Honors students enjoy the benefits of close supervision and mentoring, as they work one-on-one with faculty in select upper-division departmental courses. Honors students also complete a senior project, which provides another opportunity to collaborate with faculty on a problem that is significant, both personally and in the student's discipline. Participating in departmental honors enhances students' chances for obtaining fellowships and admission to graduate school. Minimum GPA requirements for participation in departmental honors vary by department, but usually fall within the range of 3.30-3.50. Students may enter the Honors Program at almost any stage in their academic career, including at the junior (and sometimes senior) level. The campus-wide Honors Program, which is open to all qualified students regardless of major, offers a rich array of cultural and social activities, special classes, and the benefit of Honors early registration. Interested students should contact the Honors Program, Main 15, (435) 797-2715, honors@cc.usu.edu. Additional information can be found online at: **http://www.usu.edu/honors/**

Financial Support

Scholarships, assistantships, grants-in-aid, and work-study programs are available through the University. In addition, the department employs undergraduate and graduate students to assist in engineering research and development.

Concurrent BS/Master's Program

The concurrent BS/Master's program allows engineering students to begin taking graduate-level classes during their senior year. This permits them to complete requirements for both the BS degree and the master's degree concurrently in five years. Students in this program have a greater selection of graduate courses, since many graduate courses are taught during alternate years. In addition, the student's senior design project could be a start for a graduate design project or thesis. Both the BS and the master's degree can generally be earned with 150 total credits. The department requires that students have a minimum GPA of 3.3, both overall and during the last 60 semester credits, in order to qualify for acceptance into the concurrent BS/Master's program. (For more information, see the *College of Engineering* section of this catalog, pages 123-124.)

Additional Information

For more information about Bachelor of Science requirements and the sequence in which courses should be taken, see the major requirement sheet, available from the Electrical and Computer Engineering Department, or online at:
http://www.usu.edu/majorsheets/

Graduate Programs

Admission Requirements

See general admission requirements on pages 101-102. Applicants with a bachelor's degree in Electrical or Computer Engineering from an ABET accredited program and having a 3.1 GPA or better can generally be admitted without restriction. Additional coursework in electrical and computer engineering fundamentals may be required in individual cases. Students must take the general GRE exam; however, the subject GRE is not required. All graduate students are expected to have a working knowledge of a high-level computer language (preferably C or C++).

Applications will be considered throughout the year. However, students desiring financial aid should submit application materials by January 1 to be considered for the following fall semester and July 1 to be considered for the following spring semester.

No applications will be considered until all required information arrives in the office of the School of Graduate Studies.

Degree Requirements

Specific requirements for the ME, MS, and PhD degrees are outlined below; these are in addition to the general requirements of the School of Graduate Studies.

Master of Engineering (ME) and Master of Science (MS)

The ME degree is based on coursework and is designed to give graduates a strong practical foundation. The MS degree requires substantial thesis or project work in a specific area and prepares students for advanced study or advanced work in that area. The MS degree has two options. Under Plan A, the student completes a thesis. Under Plan B, the student prepares an engineering project report.

If a student initially chooses an MS degree, changing to the ME degree is only possible by approval of the major professor, ECE graduate committee, and the department head.

The MS and ME degrees require successful completion of 30 credits of 5000-level or above coursework in a program approved by the student's supervisory committee, with the following stipulations:

Master of Science (Electrical Engineering)

1. At least 3 credits of ECE coursework must be completed at the 7000 level.
2. At least 12 credits of ECE coursework must be completed at or above the 6000 level.
3. MS Plan A students must complete 6 credits of Thesis Research (ECE 6970).
4. MS Plan B students must complete 3 credits of Thesis Research (ECE 6970) and 3 credits of Design Project (ECE 6950).
5. No more than three 5000-level ECE courses or non-ECE courses may be applied toward the MS degree.
6. MS students must have a one- to two-page, double-spaced thesis or project proposal approved by their committee when a project has been identified.

Master of Science (Computer Engineering)

1. At least 12 credits (excluding thesis and ECE 6800 seminar) must be completed in Electrical or Computer Engineering.
2. At least two sequences in Electrical or Computer Engineering or Computer Science, with at least one of the sequences in core Computer Engineering courses, must be completed.
3. MS Plan A students must complete 6 credits of Thesis Research (ECE 6970).
4. MS Plan B students must complete 3 credits of Thesis Research (ECE 6970) and 3 credits of Design Project (ECE 6950).
5. No more than four 5000-level ECE courses or CS courses, or non-ECE/CS courses, may be applied toward the MS degree.

Master of Engineering (Electrical Engineering *or* Computer Engineering Specialization)

1. At least 18 credits of ECE coursework must be completed at or above the 5000 level.
2. At least one ECE depth course (having a graduate-level prerequisite) is required.
3. At least 15 credits of 6000-level or above coursework (excluding ECE 6800) are required.
4. At least 3 credits of Professional Experience (ECE 6250 Internship or a lab-intensive course) are required. Up to 6 credits of ECE 6250 Internship are allowed.
5. A maximum of 12 credits outside of the Electrical and Computer Engineering Department may be allowed, based upon a comprehensive academic plan. Courses must be approved by the Master of Engineering advisor.

All Master's Students

1. One credit of ECE 6800 (Electrical Engineering Colloquium) must be completed as soon as possible.
2. Each master's student must form a committee and have a program of study approved by the end of his or her first semester.
3. Any exceptions to the master's requirements must be approved by the student's committee and the ECE Graduate Committee.

A course in technical and professional writing, or equivalent writing experience, is required for MS students prior to beginning the thesis. This may be fulfilled as a requirement for a bachelor's degree. MS students may, at the discretion of their supervisors, be required to hire an editor to bring the thesis or paper into acceptable form.

Doctor of Philosophy

To qualify for a PhD degree, a student is expected *either* to complete at least 51 credits beyond the requirements for a BS degree; *or* to complete at least 21 credits beyond the requirements for an MS degree, *plus* complete enough credits of dissertation research to have a total of 90 credits beyond the BS degree or 60 credits beyond the MS degree. Completion of this coursework generally requires three semesters of study beyond the MS degree, with up to 18 credits beyond the BS degree being taken in courses outside the Electrical and Computer Engineering Department.

After a student has completed at least 18 credits of coursework beyond the MS degree, he or she must pass a comprehensive examination based on graduate-level courses, as well as pass a dissertation research proposal defense. The comprehensive examination will be given *only* after a student has applied and received permission to take the exam. Near the end of the program, the results of the original (publishable) research work will be presented and publicly defended as a dissertation.

For further information, visit the departmental website at:
http://www.engineering.usu.edu/ece/

Research

The department conducts extensive research through the following centers:

1. Center for Self-Organizing Intelligent Systems (CSOIS)
2. National Center for the Design of Molecular Function (NCDMF)
3. Space Dynamics Laboratory (SDL)
4. Anderson Center for Wireless Teaching and Research
5. Center for High-Speed Information Processing (CHIP)
6. Center for Advanced Imagery LADAR (CAIL)

Research activities include: robotics, control systems, digital system design, computer networks, concurrent systems, antennas, space systems, image processing, digital signal processing, wireless communications, acoustics, electromagnetic compatibility, and LADAR systems.

Department of Electrical and Computer Engineering

Financial Assistance

All applicants who are accepted academically are automatically considered for financial aid. Many successful graduate students in the department do receive some level of financial aid during their degree program.

Electrical and Computer Engineering Faculty

Professors
Doran J. Baker, electromagnetics, infrared measurements, engineering systems in space
Tamal Bose, digital signal processing, communications
H. Scott Hinton, photonic switching
Todd K. Moon, communications and signal processing
Krishna Shenai, electronic systems
Charles M. Swenson, space science and space engineering

Adjunct Professor
Heng-Da Cheng, pattern recognition, image processing

Trustee Professor Emeritus
Kay D. Baker, electronics, space science

Professors Emeritus
Robert W. Gunderson, control systems, pattern recognition, robotics
Ronney D. Harris, microwaves, transmission line circuits, atmospheric modeling
William L. Jones, integrated circuits
Alan W. Shaw, electromagnetics, controls, microcomputers
Allan J. Steed, electro-optics, aerospace measurement systems
Gardiner S. "Dyke" Stiles, concurrent systems
Ronald L. Thurgood, computers, database systems
Clair L. Wyatt, infrared, electro-optical systems

Associate Professors
Scott E. Budge, signal processing, image processing
Jacob H. Gunther, communications and signal processing
Paul A. Wheeler, microprocessors, acoustics

Research Associate Professors
Paul D. Israelsen, integrative services, digital systems design
Robert T. Pack, geological and geomatics engineering

Adjunct Associate Professors
R. Rees Fullmer, control systems, space engineering
Ronald J. Huppi, space research
John C. Kemp, robotics, electro-optics
Tsung-Cheng Shen, physics
Gene A. Ware, computer systems

Associate Professor Emeritus
Duane G. Chadwick, remote sensors, instrumentation

Assistant Professors
Reyhan Baktur, electromagnetics
Yang Quan Chen, control systems
Aravind Dasu, computer engineering
Brandon K. Eames, computer engineering
Wei Ren, controls
Edmund Spencer, space science and engineering
Chris Winstead, analog VLSI

Principal Lecturer
Donald L. Cripps, control systems, robotics

Research Assistant Professor
Hui Fang Dou, precision instruments, mechatronics

Adjunct Research Assistant Professor
Randy J. Jost, electromagnetic fields, solid state, microwaves

Course Descriptions

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