Computer Engineering (ECE)

Major in Computer Engineering

Department of Electrical and Computer Engineering, College of Engineering and Applied Sciences

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Minors of particular interest to students majoring in Electrical or Computer Engineering: Applied Mathematics and Statistics (AMS), Computer Science (CSE), Science and Engineering (LSE), Engineering and Technology Entrepreneurship (ETE)

Computer Engineering (ECE)

Computer Engineering is one of the College of Engineering and Applied Sciences (CEAS) programs leading to the Bachelor of Engineering degree. The Computer Engineering program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org. As technology continually advances, the solutions to design problems in computer and data processing equipment more frequently encompass both hardware and software solutions. It is important for students who wish to specialize in computer engineering to be fluent in both the newest software techniques as well as digital electronics and the application of large-scale integrated devices. The curriculum of the Computer Engineering program prepares students to meet these objectives.

Students gain a solid foundation to enable them to adapt successfully throughout their professional careers. The first two years of study provide a strong foundation in fundamental courses in mathematics, sciences, writing, and core electrical engineering. In the junior and senior years, students take computer engineering courses as well as other upper-level computer science courses and technical electives such as computer communications, digital signal processing, digital image processing, computer vision, and embedded microprocessor system design. They also carry out hands-on laboratories and internships to apply the theoretical training, and meet with faculty advisors to consult on course selection, academic progress, and career preparation. In the final year of study, students work in teams and complete an original design project under the supervision of a faculty member.

Computer engineers design digital systems, a majority of which are microprocessor-based systems. The systems include a wide variety of consumer products, industrial machinery, and specialized systems such as those used in flight control or automotive anti-lock brakes. Students may work as interns in engineering and high-technology industries in Long Island corporate offices such as BAE Systems, Omnicom Group, and Motorola and as graduates they are employed in these corporations, in New York City, and across the country. These include Ford Motor, Boeing, GE Energy, and Texas Instruments. A large number of major and international financial institutions including Citigroup and Goldman Sachs also employ Stony Brook computer engineering graduates. Many baccalaureate graduates choose to go on to graduate school in engineering, business, law, and medicine.

Program Educational Objectives

The computer engineering program has five program educational objectives (PEOs):

PEO 1: Our graduates should excel in engineering positions in industry and other organizations that emphasize design and implementation of engineering systems and devices.

PEO 2: Our graduates should excel in the best graduate schools, reaching advanced degrees in engineering and related disciplines.

PEO 3: Within several years from graduation, our alumni should have established a successful career in an engineering-related multidisciplinary field, leading or participating effectively in interdisciplinary engineering projects, as well as continuously adapting to changing technologies.

PEO 4: Our graduates are expected to continue personal development through professional study and self-learning.

PEO 5: Our graduates are expected to be good citizens and cultured human beings, with full appreciation of the importance of professional, ethical and societal responsibilities.

Student Outcomes

To prepare students to meet the above program educational objectives, a set of program outcomes that describes what students should know and be able to do when they graduate, have been adopted. We expect our graduates to attain:

a. an ability to apply knowledge of mathematics, science, and engineering;

b. an ability to design and conduct experiments, as well as to analyze and interpret data;

c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
d. an ability to function on multidisciplinary teams;

e. an ability to identify, formulate, and solve engineering problems;

f. an understanding of professional and ethical responsibility;

g. an ability to communicate effectively;

h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;

i. a recognition of the need for ability to engage in life-long learning;

j. a knowledge of contemporary issues; and

k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

More details about program educational objectives and outcomes can be found at http://www.ece.sunysb.edu/peos

Requirements for the Major in Computer Engineering (ECE)

Acceptance into the Computer Engineering Major

Freshman and transfer applicants who have specified their interest in the major in Computer Engineering may be accepted into the major upon admission to the University. Applicants admitted to the University but not immediately accepted into the Computer Engineering major may apply for acceptance at any time during the academic year. The Department's undergraduate committee will consider an application only if the following conditions have been met:

1. the student has completed at least 11 credits of mathematics, physics, electrical and computer engineering, or computer science courses required for the major;

2. the student has earned a grade point average of 3.00 or higher in these courses with no grade in any of them lower than C;

3. no courses required for the major have been repeated;

4. all transfer courses have been evaluated.

Completion of the major requires approximately 110 credits.

1. Mathematics

- AMS 151, AMS 161 Applied Calculus I, II
- AMS 210 or MAT 211 Applied Linear Algebra
- AMS 361 or MAT 303 Applied Calculus IV
- AMS 301 Finite Mathematical Structures

Note: The following alternate calculus course sequences may be substituted for AMS 151, AMS 161 in major requirements or prerequisites: (MAT 131 and MAT 132) or (MAT 131 and MAT 171) or (MAT 125, MAT 126 and MAT 127) or (MAT 141 and MAT 142), or (MAT 141 and MAT 171).

2. Natural Sciences & Mathematics

- One 4-credit course or two 3-credit courses from CHE 131, ESG 198, BIO 202 & BIO 204, BIO 203 & BIO 205, PHY 251 & PHY 252, AMS 261
- PHY 131/PHY 133, PHY 132/PHY 134 Classical Physics I, II and laboratories

Note: The physics course sequence PHY 125, PHY 126, PHY 127, PHY 133, PHY 134 or PHY 141, PHY 142, PHY 133, PHY 134 is accepted in lieu of PHY 131/PHY 133, PHY 132/PHY 134 (Students are advised to take PHY 127 before PHY 126).

3. Freshman Introduction to Computer Engineering

- ESE 123 Introduction to Electrical and Computer Engineering
- ESE 124 Computer Techniques for Electronic Design I

4. Engineering Topics

Engineering topics include engineering science and engineering design. Content of the former category is determined by the creative application of basic science skills, while the content of the latter category focuses on the procedure of devising systems, components, or processes.

a. Engineering Sciences

- ESE 211 Electronics Laboratory A
• ESE 218 Digital Systems Design
• ESE 271 Electrical Circuit Analysis
• ESE 305 Deterministic Signals and Systems
• ESE 345 Computer Architecture
• ESE 372 Electronics

b. Engineering Design
• ESE 380 Embedded Microprocessor Systems Design I
• ESE 382 Digital Design Using VHDL and PLDs
• ESE 440 Engineering Design I
• ESE 441 Engineering Design II

Note: ESE 440 and ESE 441 are engineering design projects that must be carried out at Stony Brook under the supervision of an Electrical and Computer Engineering faculty member.

5. Probability and Statistics
• ESE 306 Random Signals and Systems

6. Computer Science
• CSE 114 Computer Science I
• CSE 214 Computer Science II
• CSE 230 Intermediate Programming in C and C++ or ESE 224 Computer Techniques for Electronic Design II
• ESE 333 Real-time Operating Systems or CSE 306 Operating Systems

7. Engineering Technical Electives
• One course from: ESE 330 or ESE 356 or ESE 366 or ESE 355 or ESE 381
• One course from: ESE 304 or ESE 347 or CSE 219
• Two courses from: CSE 376, ESE 344, ESE 346, ESE 347, ESE 355, ESE 356, ESE 357, ESE 358, ESE 360, ESE 366, ESE 381
• Two courses from: ESE 304, ESE 307, ESE 311, ESE 314, ESE 315, ESE 319, ESE 322, ESE 323, ESE 324, ESE 330, ESE 337, ESE 340, ESE 342, ESE 344, ESE 346, ESE 347, ESE 355, ESE 356, ESE 357, ESE 358, ESE 360, ESE 366, ESE 373, ESE 381, ESE 476, CSE 219, CSE 376

8. Engineering Ethics
• ESE 301 Engineering Ethics and Societal Impact

9. Upper-Division Writing Requirement: ESE 300 Writing in Electrical/Computer Engineering

All degree candidates must demonstrate skill in written English at a level acceptable for computer engineering majors. Students must register for the writing course ESE 300 concurrently with or after completion of ESE 314, ESE 324, ESE 380, or ESE 382. Students whose writing does not meet the required standard are referred for remedial help. Detailed guidelines are provided by the Department.

Grading

All courses taken to satisfy requirements 1 through 9 must be taken for a letter grade. A letter grade of C or higher is required in the following courses:
• AMS 151 and AMS 161 (or MAT 125, MAT 126, and MAT 127 or MAT 131 and MAT 132)
• PHY 131/PHY 133 and PHY 132/PHY 134 (or PHY 125, PHY 126, and PHY 127)
• ESE 211, ESE 218, ESE 271, ESE 300, ESE 301, ESE 440, ESE 441, ESE 345, ESE 372, ESE 380, and ESE 382
• CSE 114, CSE 214, and CSE 230
• Six ESE technical electives

Honors Program in Computer Engineering

The purpose of the honors program in Computer Engineering is to give high achieving students an opportunity to receive validation for a meaningful research experience and for a distinguished academic career. A student interested in becoming a candidate for the honors program in Computer Engineering may apply to the program at the end of the sophomore year. To be admitted to the honors program, students need a minimum cumulative grade point average of 3.50 and a B or better in all major required courses (including math and physics). Transfer students who enter Stony Brook University in the junior year need a minimum cumulative grade point average of 3.50 and a B or better in all required major courses (including math and physics) in their first semester at Stony Brook University.

Graduation with departmental honors in Computer Engineering requires the following:

1. A cumulative grade point average of 3.50 or higher and a B or better in all major required courses (including math and physics) upon graduation.

Stony Brook University: www.stonybrook.edu/ugbulletin
2. Completion of ESE 494, a 1 credit seminar on research techniques, with a B or better during the junior year.
3. Completion of ESE 495, a 3-credit honors research project, with a B or better.
4. Presentation of an honors thesis (written in the format of an engineering technical paper) under the supervision of an ECE faculty member.
   The thesis must be presented to and approved by a committee of two faculty members including the student’s advisor.

For students who qualify, this honor is indicated on their diploma and on their permanent academic record.

Requirements for the Accelerated B.E. Computer Engineering/M.S. Computer Engineering or Electrical Engineering Degrees

The intent of the accelerated five-year Bachelor of Engineering in Computer Engineering and Master of Science in Electrical Engineering program is to prepare high-achieving and highly motivated undergraduate computer engineering students for either doctoral studies or a variety of advanced professional positions. Computer engineering students interested in the accelerated program should apply through the undergraduate office of the Department of Electrical and Computer Engineering. The program is highly selective and is offered to the top 10 to 20 percent of the junior undergraduate class. Admission is based on academic performance (a major g.p.a. of at least 3.30) as well as undergraduate research and professional activities. The accelerated program is as rigorous as the current B.E. and M.S. programs taken separately. The requirements for the accelerated program are the same as the requirements for the B.E. and M.S. programs except that two 300-level electives in the B.E. program are substituted by two 500-level graduate courses. Therefore six graduate credits will be counted towards the undergraduate degree. Detailed guidelines and sample course sequences are provided by the Department.

**Sample Course Sequence for the Major in Computer Engineering**

<table>
<thead>
<tr>
<th>FRESHMAN</th>
<th>Credits</th>
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<tr>
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<tr>
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<td>WRT 102 (WRT)</td>
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<tr>
<td>AMS 151 or MAT 131 (QPS)</td>
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<tr>
<td>PHY 131/133 (SNW)</td>
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<tr>
<td>ESE 123 (TECH)</td>
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<td><strong>Total</strong></td>
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<tr>
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<tbody>
<tr>
<td>First Year Seminar 102</td>
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</tr>
<tr>
<td>AMS 161 or MAT 132 (QPS)</td>
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<tr>
<td>PHY 132/134</td>
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<tr>
<td>ESE 124</td>
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<tr>
<td>ESE 218</td>
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<td><strong>Total</strong></td>
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<tr>
<th>SOPHOMORE</th>
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<tr>
<td><strong>FALL</strong></td>
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<tr>
<td>AMS 361 or MAT 303</td>
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<tr>
<td>ESE 380</td>
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<td>ESE 271</td>
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<tr>
<td>ESE 224</td>
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<tr>
<td>SBC</td>
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<thead>
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<tr>
<td>AMS 210 or MAT 211</td>
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<tr>
<td>ESE 372</td>
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<td>ESE 382</td>
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### JUNIOR

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<tr>
<td>CSE 214</td>
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<tr>
<td>AMS 301</td>
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</tr>
<tr>
<td>ESE 305</td>
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<tr>
<td>ESE 345</td>
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<tr>
<td>SBC</td>
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<tr>
<td>ESE Elective (^1)</td>
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### SPRING

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<tr>
<td>ESE Elective (^2)</td>
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<tr>
<td>ESE 306</td>
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<tr>
<td>ESE 300</td>
<td>3</td>
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<tr>
<td>ESE 333 (or CSE 306)</td>
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<tr>
<td>ESE 301 (STAS, CER)</td>
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### SENIOR

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<tbody>
<tr>
<td>ESE 440(^*)</td>
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<tr>
<td>ESE Elective (^3)</td>
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</tr>
<tr>
<td>ESE Elective (^4)</td>
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</tr>
<tr>
<td>Math elective</td>
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</tr>
<tr>
<td>SBC</td>
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<td><strong>Total</strong></td>
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<table>
<thead>
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<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ESE 441(^*)</td>
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<tr>
<td>ESE Elective (^3)</td>
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<tr>
<td>ESE Elective (^4)</td>
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<tr>
<td>SBC</td>
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<tr>
<td>SBC</td>
<td>3</td>
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<tr>
<td><strong>Total</strong></td>
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Elective list 1: One course from: ESE 330 or ESE 355 or ESE 356 or ESE 366 or ESE 381

Elective list 2: One course from: ESE 304 or ESE 347 or CSE 219

Elective list 3: Two courses from: CSE 376, ESE 344, ESE 346, ESE 347, ESE 355, ESE 356, ESE 357, ESE 358, ESE 360, ESE 366, ESE 381
Elective list 4: Two courses from: ESE 304, ESE 307, ESE 311, ESE 314, ESE 315, ESE 319, ESE 322, ESE 323, ESE 324, ESE 330, ESE 337, ESE 340, ESE 342, ESE 344, ESE 346, ESE 347, ESE 355, ESE 356, ESE 357, ESE 358, ESE 360, ESE 366, ESE 373, ESE 381, ESE 476, CSE 219, CSE 376

Math or Science elective: one 4-credit course or two 3-credit courses from CHE 131, CHE 141, ESG 198, BIO 202 & BIO 204, BIO 203 & BIO 205, PHY 251 & PHY 252, AMS 261

*Note: This course partially satisfies the following: ESI, CER, SPK, WRTD, SBS+, STEM+, EXP+. For more information contact the CEAS Undergraduate Student Office.
ESE 121: Introduction to Audio Systems
Analog and digital audio systems, musical instrument amplifiers and effects, audio instrumentation, samplers, synthesizers, and audio transducers will be studied. Signal and system concepts will be demonstrated using audible examples to develop intuitive and non-mathematical insights. Audio system specifications will be explained and their effects demonstrated.

SBC: TECH
3 credits

ESE 123: Introduction to Electrical and Computer Engineering
Introduces basic electrical and computer engineering concepts in a dual approach that includes: laboratories for hands-on wired and computer simulation experiments in analog and logic circuits, and lectures providing concepts and theory relevant to the laboratories. Emphasizes physical insight and applications rather than theory.

Pre-or Corequisites: AMS 151 or MAT 125 or 131 or 141; PHY 125 or 131 or 141

SBC: TECH
4 credits

ESE 124: Computer Techniques for Electronic Design I
An extensive introduction to problem solving in electrical engineering using the ANSI C language. Topics covered include data types, operations, control flow, functions, data files, numerical techniques, pointers, structures, and bit operations. Students gain experience in applying the C language to the solution of a variety of electrical engineering problems, based on concepts developed in ESE 123.

Knowledge of C at the level presented in this course is expected of all electrical engineering students in subsequent courses in the major.

Pre-or Corequisites: AMS 151 or MAT 125 or 131 or 141; ESE 123 or equivalent
3 credits

ESE 201: Engineering and Technology Entrepreneurship
The purpose of this course is to bridge the gap between technical competence and entrepreneurial proficiency. Students are not expected to have any formal business background, but have some background in a technical field. These fields can range from the engineering disciplines to computer science, and from biology and chemistry to medicine. Accordingly, the course will provide the necessary exposure to the fundamentals of business, while minimizing the use of business school jargon. Entrepreneurship is considered as a manageable process built around innovativeness, risk-taking and proactiveness. The course focuses on ventures where the business concept is built around either a significant technical advance in an operational process, or in the application of technology to create a new product or service.

Prerequisite: BME 100 or CME 101 or ESG 100 or ESE 123 or MEC 101 or EST 192 or EST 194 or EST 202 or LSE 320
3 credits

ESE 211: Electronics Laboratory A
Introduction to the measurement of electrical quantities; instrumentation; basic circuits, their operation and applications; electronic devices; amplifiers, oscillators, power supplies, wave-shaping circuits, and basic switching circuits.

Prerequisite: ESE 271
Corequisite: ESE 372
2 credits

ESE 218: Digital Systems Design
Develops methods of analysis and design of both combinational and sequential systems regarding digital circuits as functional blocks. Utilizes demonstrations and laboratory projects consisting of building hardware on breadboards and simulation of design using CAD tools. Topics include: number systems and codes; switching algebra and switching functions; standard combinational modules and arithmetic circuits; realization of switching functions; latches and flip-flops; standard sequential modules; memory, combinational, and sequential PLDs and their applications; design of system controllers.

Prerequisite or Corequisite: PHY 127/134 or PHY 132/134 or PHY 142 or ESE 124

SBC: TECH
4 credits

ESE 224: Computer Techniques for Electronic Design II
Introduces C++ programming language for problem solving in electrical and computer engineering. Topics include C++ structures, classes, abstract data types, and code reuse. Basic object-oriented programming concepts as well as fundamental topics of discrete mathematics and algorithms are introduced.

Prerequisite: ESE 124
3 credits

ESE 231: Introduction to Semiconductor Devices
The principles of semiconductor devices, Energy bands, transport properties and generation recombination phenomena in bulk semiconductors are covered first, followed by junctions between semiconductors and metal-semiconductor. The principles of operation of diodes, transistors, light detectors, and light emitting devices based on an understanding of the character of physical phenomena in semiconductors. Provides background for subsequent courses in electronics.

Prerequisites: AMS 361 or MAT 303; PHY 127/134 or PHY 132/134 or PHY 142
3 credits

ESE 271: Electrical Circuit Analysis I
Kirchoff's Laws, Ohm's Law, nodal and mesh analysis for electric circuits, capacitors, inductors, and steady-state AC; transient analysis using Laplace Transform. Fundamentals of AC power, coupled inductors, and two-ports.

Prerequisites: AMS 161 or MAT 127 or 132 or 142 or 171; PHY 127/134 or PHY 132/134 or PHY 142
4 credits

ESE 290: Transitional Study
A vehicle used for transfer students to remedy discrepancies between a Stony Brook course and a course taken at another institution. For example, it allows the student to take the laboratory portion of a course for which he or she has had the theoretical portion elsewhere. Open elective credit only.

Prerequisite: Permission of department
1-3 credits

ESE 300: Technical Communication for Electrical and Computer Engineers
Topics include how technical writing differ from other forms of writing, the components of technical writing, technical style, report writing, technical definitions, proposal writing, writing by group or team, instructions and manuals, transmittal letters, memoranda, abstracts and summaries, proper methods of documentation, presentations and briefings, and analysis of published engineering writing. Also covered are the writing of resumes and cover letters.

Prerequisite: WRT 102; ESE or ECE major, U3 standing;
Pre- or Corequisite: ESE 314 or 324 or 380 or 382
3 credits
ESE 301: Engineering Ethics and Societal Impact
The study of ethical issues facing engineers and engineering-related organizations and the societal impact of technology. Decisions involving moral conduct, character, ideals and relationships of people and organizations involved in technology, the interaction of engineers, their technology, the society and the environment is examined using case studies.
Prerequisite: U3 or U4 standing; one D.E.C. E or SNW course
DEC: H
SBC: STAS
3 credits

ESE 304: Applications of Operational Amplifiers
Design of electronic instrumentation: structure of basic measurement systems, transducers, analysis and characteristics of operational amplifiers, analog signal conditioning with operational amplifiers, sampling, multiplexing, A/D and D/A conversion; digital signal conditioning, data input and display, and automated measurement systems. Application of measurement systems to pollution and to biomedical and industrial monitoring is considered.
Prerequisite: ESE 372
3 credits

ESE 305: Deterministic Signals and Systems
Pre- or Corequisite: ESE 271
3 credits

ESE 306: Random Signals and Systems
Random experiments and events; random variables, probability distribution and density functions, continuous and discrete random processes; Binomial, Bernoulli, Poisson, and Gaussian processes; system reliability; Markov chains; elements of queuing theory; detection of signals in noise; estimation of signal parameters; properties and application of auto-correlation and cross-correlation functions; power spectral density; response of linear systems to random inputs.
Pre- or Corequisite: ESE 305
4 credits

ESE 311: Analog Integrated Circuits
Engineering design concepts applied to electronic circuits. Basic network concepts, computational analysis and design techniques: models of electronic devices; biasing and compensation methods; amplifiers and filters designed by conventional and computer-aided techniques.
Prerequisite: ESE 372
3 credits

ESE 314: Electronics Laboratory B
Laboratory course on design and operation of basic building blocks of electronics. The course is coordinated with, and illustrates and expands upon, concepts presented in ESE 372. Emphasis is given to design solutions more relevant to integrated rather than to discrete element electronics. Field effect transistors are given special attention due to their importance in contemporary analog and digital IC. Frequency responses of the basic amplifiers and active filters are analyzed. Internal structure and fundamental performance limitations of digital inverter and other gates are studied.
Prerequisites: ESE or ECE major; ESE 211 and 372 or permission of instructor
3 credits

ESE 315: Control System Design
Prerequisite: ESE 271
3 credits

ESE 319: Electromagnetics and Transmission Line Theory
Fundamental aspects of electromagnetics wave propagation and radiation, with application to the design of high speed digital circuits and communications systems. Topics include: solutions of Maxwell's equations for characterization of EM wave propagation in unbounded and lossy media; radiation of EM energy; guided wave propagation with emphasis on transmission lines theory.
Prerequisite: ESE 271
3 credits

ESE 324: Electronics Laboratory C
Illustrates and expands upon advanced concepts presented in ESE 372. Experiments include analog circuits such as oscillators, voltage regulators; mixed -signal circuits such as data converters, phase - locked loops, and several experiments emphasizing the analog design issues in digital circuits. Laboratory fee required.
Prerequisites: ESE or ECE major; U3 standing; ESE 211 and 372
2 credits

ESE 325: Modern Sensors
The course focuses on the underlying physics principles, design, and practical implementation of sensors and transducers including piezoelectric, acoustic, inertial, pressure, position, flow, capacitive, magnetic, optical, and bioelectric sensors. Established as well as novel sensor technologies as well as problems of interfacing various sensors with electronics are discussed.
Prerequisite: ESE 372
3 credits

ESE 330: Integrated Electronics
An overview of the design and fabrication of integrated circuits. Topics include gate-level and transistor-level design; fabrication material and processes; layout of circuits; automated design tools. This material is directly applicable to industrial IC design and provides a strong background for more advanced courses.
Prerequisite: ESE 372
3 credits

ESE 333: Real-Time Operating Systems
Introduces basic concepts and principles of real-time operating systems. Topics include structure, multiple processes, interprocess communication, real-time process scheduling, memory management, virtual memory, file system design, security, protection, and programming environments for real-time systems.
Prerequisites: ESE 124; CSE 214; ESE 380 or CSE 220
3 credits

ESE 337: Digital Signal Processing: Theory
Introduces digital signal processing theory sequences, discrete-time convolution,
difference equations, sampling and reconstruction of signals, one- and two-sided Z-transforms, transfer functions, and frequency response. Design of FIR and IIR filters. Discrete and fast Fourier transforms and applications.

Prerequisite: ESE 305
3 credits

ESE 340: Basic Communication Theory
Basic concepts in both analog and digital data communications; signals, spectra, and linear networks; Fourier transforms, energy and power spectra, and filtering; AM, FM, and PM; time and frequency multiplexing; discussion of problems encountered in practice; noise and bandwidth considerations; pulse modulation schemes.

Prerequisites: ESE 305 and 306
3 credits

ESE 341: Introduction to Wireless and Cellular Communication
Basic concepts of wireless cellular communications, radio frequency, spectrum reuse, radio channel characterization, path loss and fading, multiple access techniques, spread spectrum systems, channel coding, specific examples of cellular communication systems.

Pre or Co-requisite: ESE 340
3 credits

ESE 342: Digital Communications Systems

Prerequisite: ESE 340
3 credits

ESE 344: Software Techniques for Engineers
Trains students to use computer systems to solve engineering problems. Includes C/C++ programming languages, UNIX programming environment, basic data structures and algorithms, and object oriented programming.

Prerequisites: ESE 218; CSE 230 or ESE 224
3 credits

ESE 345: Computer Architecture
Starts with functional components at the level of registers, buses, arithmetic, and memory chips, and then uses a register transfer language to manipulate these in the design of hardware systems up to the level of complete computers. Specific topics included are microprogrammed control, user-level instruction sets, I/O systems and device interfaces, control of memory hierarchies, and parallel processing organizations.

Prerequisites for CSE majors: CSE 220 and ESE 218
Prerequisite for ESE and ECE majors: ESE 380
3 credits

ESE 346: Computer Communications
Basic principles of computer communications. Introduction to performance evaluation of protocols. Protocols covered include those for local, metropolitan, and wide area networks. Introduction to routing, high-speed packet switching, circuit switching, and optical data transport. Other topics include TCP/IP, Internet, web server design, network security, and grid computing. Not for credit in addition to CSE/ESE 310. This course is offered as both CSE 346 and ESE 346.

Pre- or corequisite for ESE and ECE majors: ESE 306
Pre- or corequisite for CSE majors: AMS 310 or 311
3 credits

ESE 347: Digital Signal Processing: Implementation
Fundamental techniques for implementing standard signal-processing algorithms on dedicated digital signal-processing chips. Includes a review of discrete-time systems, sampling and reconstruction, FIR and IIR filter design, FFT, architecture and assembly language of a basic signal processing chip, and an introduction to adaptive filtering.

Prerequisites: ESE 337, or ESE 305 and 380
4 credits

ESE 350: Electrical Power Systems
Fundamental engineering theory for the design and operation of an electric power system. Modern aspects of generation, transmission, and distribution are considered with appropriate inspection trips to examine examples of these facilities. The relationship between the facilities and their influence on our environment is reviewed. Topics include power system fundamentals, characteristics of transmission lines, generalized circuit constants, transformers, control of power flow and of voltage, per unit system of computation, system stability, and extra-high voltage AC and DC transmission.

Prerequisite: ESE 271
3 credits

ESE 352: Electromechanical Energy Converters
Basic principles of energy conversion; DC, induction, and synchronous rotary converters; the three-phase system and symmetrical components; the relationships between voltage, current, flux, and m.m.f.; equivalent circuits and operating characteristics of rotary converters; and analysis of saturation effects.

Prerequisite: ESE 372
3 credits

ESE 355: VLSI System Design
Introduces techniques and tools for scalable VLSI design and analysis. Emphasis is on physical design and on performance analysis. Includes extensive laboratory experiments and hands-on use of CAD tools.

Prerequisite: ESE 218
4 credits

ESE 356: VLSI System Specification and Modeling
Introduces concepts of specification and modeling for design at various levels of abstraction. High Level specification language is used for executable models creation, representing possible architecture implementations. Topics include design space exploration through fast simulation and re-use of models and implementation.

Prerequisites: ESE 124 and ESE 380
3 credits

ESE 358: Computer Vision
Introduces fundamental concepts, algorithms, and computational techniques in visual information processing. Covers image formation, image sensing, binary image analysis, image segmentation, Fourier image analysis, edge detection, reflectance map, photometric stereo, basic photogrammetry, stereo, pattern classification, extended Gaussian images, and the study of human visual system from an information processing point of view.

Prerequisites for ESE and ECE majors: ESE 305; ESE 224 or CSE 230
Prerequisites for CSE majors: CSE 214 and 220
3 credits

ESE 360: Network Security Engineering
An introduction to computer network and telecommunication network security engineering. Special emphasis on building security into hardware and hardware working with software. Topics include encryption, public key cryptography, authentication, intrusion detection, digital rights management,
firewalls, trusted computing, encrypted computing, intruders and viruses. Not for credit in addition to CSE 408.

Prerequisite: ESE/CSE 346 or CSE/ISE 310
3 credits

ESE 363: Fiber Optic Communications
Design of single and multi-wavelength fiber optic communications systems. Topics include analysis of optical fibers, optical transmitters and receiver design, optical link design, single-wavelength fiber optic networks with analysis of FDDI and SONET/SDH, and wavelength division multiplexing.

Prerequisite: ESE 372
4 credits

ESE 366: Design using Programmable Mixed-Signal Systems-on-Chip
This course focuses on development of mixed-signal embedded applications that utilize systems on chip (SoC) technology. The course discusses design issues such as: implementation of functionality; realizing new interfacing capabilities; and improving performance through programming the embedded microcontroller and customizing the reconfigurable analog and digital hardware of SoC.

Prerequisites: ESE 380 and ESE 372; ESE 224 or CSE 230
4 credits

ESE 372: Electronics
The pertinent elements of solid-state physics and circuit theory are reviewed and applied to the study of electronic devices and circuits, including junction diodes, transistors, and gate and electronic switches; large- and small-signal analysis of amplifiers; amplifier frequency response; and rectifiers and waveshaping circuits.

Prerequisite: ESE 271
Corequisite for ESE and ECE majors: ESE 211
4 credits

ESE 373: RF Electronics for Wireless Communications
Introduces basic concepts and key circuits of radio-frequency systems. Taught within the design and construction of a transceiver for wireless communications, the course covers fundamental principles which apply to all radio devices. Essential theoretical background, with additional emphasis on practical implementation using commercially-available integrated circuits for double-balanced mixers, oscillators, and audio power amplifiers. Basic components and circuits; key elements of radio electronics, including filters, matching networks, amplifiers, oscillators, mixers, modulators, detectors, and antennae. Computer simulation via Pspice and Puff is emphasized as an integral part of the design process.

Prerequisite: ESE 372
3 credits

ESE 380: Embedded Microprocessor Systems Design I
Fundamental concepts and techniques for designing electronic systems that contain a microprocessor or microcontroller as a key component. Topics include system level architecture, microprocessors, ROM, RAM, I/O subsystems, address decoding, PLDs and programmable peripheral ICs, assembly language programming and debugging. Hardware-software trade-offs in implementation of functions are considered. Hardware and software design are emphasized equally. Laboratory work involves design, implementation, and testing of microprocessor controlled circuits.

Prerequisite: ESE or ECE major; ESE 218 or permission of instructor.
4 credits

ESE 381: Embedded Microprocessor Systems Design II
A continuation of ESE 380. The entire system design cycle, including requirements definition and system specifications, is covered. Topics include real-time requirements, timing, interrupt driven systems, analog data conversion, multi-module and multi-language systems. The interface between high-level language and assembly language is covered. A complete system is designed and prototyped in the laboratory.

Prerequisites: ESE 271 and 380
4 credits

ESE 382: Digital Design Using VHDL and PLDs
Digital system design using the hardware description language VHDL and system implementation using complex programmable logic devices (CPLDs) and field programmable gate arrays (FPGAs). Topics include design methodology, VHDL syntax, entities, architectures, testbenches, subprograms, packages, and libraries. Architecture and characteristics of PLDs and FPGAs are studied. Laboratory work involves writing the VHDL descriptions and testbenches for designs, compiling, and functionally stimulating the designs, fitting and timing simulation of the fitted designs, and programming the designs into a CPLD or FPGA and bench testing.

Prerequisite: ESE or ECE major; ESE 218 or permission of instructor
4 credits

ESE 440: Engineering Design I
Lectures by faculty and visitors on typical design problems encountered in engineering practice. During this semester each student will choose a senior design project for Engineering Design II. The project incorporates appropriate engineering standards and multiple realistic constraints. A preliminary design report is required. Not counted as a technical elective.

Laboratory fee required.

Prerequisites: ESE or ECE major, U4 standing; two ESE technical electives (excluding ESE 390 and 499); ESE 300. Students may need additional prerequisites depending on the design project undertaken.
3 credits

ESE 441: Engineering Design II
Student groups carry out the detailed design of the senior projects chosen during the first semester. The project incorporates appropriate engineering standards and multiple realistic constraints. A comprehensive technical report of the project and an oral presentation are required. Not counted as a technical elective.

Laboratory fee required.

Prerequisite: ESE 440
3 credits

ESE 475: Undergraduate Teaching Practicum
Students assist the faculty in teaching by conducting recitation or laboratory sections that supplement a lecture course. The student receives regularly scheduled supervision from the faculty instructor. May be used as an open elective only and repeated once.

Prerequisites: U4 standing; permission of instructor
Laboratory fee required.

SBC: EXP+
3 credits

ESE 476: Instructional Laboratory Development Practicum
Students work closely with a faculty advisor and staff in developing new laboratory experiments for scheduled laboratory courses in electrical and computer engineering. A comprehensive technical report and the instructional materials developed must be submitted at the end of the course. May be used as a technical elective for electrical and
computer engineering majors. May be repeated as an open elective.

Prerequisites: U4 standing; minimum cumulative g.p.a. of 3.0 and minimum grade of A- in the course for which the students will develop material; permission of department and instructor

SBC: EXP+
3 credits

ESE 488: Internship in Electrical/Computer Engineering

An independent off-campus engineering project with faculty supervision. May be repeated but only three credits of internship electives may be counted toward the non-ESE technical elective requirement.

Prerequisites: ECE or ESE major; U3 or U4 standing; 3.00 g.p.a. minimum in all engineering courses; permission of department

SBC: EXP+
3 credits

ESE 494: Honors Seminar on Research

An introduction to the world wide research enterprise with special emphasis on research in the United States. Topics include research funding, publications, patents, career options, theory versus experiment, entrepreneurship and presentation skills.

Prerequisite: Acceptance into the ECE or ESE Honors programs or permission of instructor.

1 credit

ESE 495: Honors Research Project

A research project, for students in the honors program, conducted under the supervision of an electrical and computer engineering faculty member.

Prerequisite: ESE 494, permission of department
3 credits

ESE 499: Research in Electrical Sciences

An independent research project with faculty supervision. Permission to register requires a 3.00 g.p.a. in all engineering courses and the agreement of a faculty member to supervise the research. May be repeated but only three credits of research electives (AMS 487, BME 499, CSE 487, MEC 499, ESM 499, EST 499, ISE 487) may be counted toward non-ESE technical elective requirements.

Requirements: U4 standing, 3.00 g.p.a. minimum in all engineering courses, permission of department
0-3 credits