Electrical Engineering (ESE)
Major and Minor in Electrical 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)

Electrical Engineering (ESE)

Electrical Engineering is one of the College of Engineering and Applied Sciences (CEAS) programs leading to the Bachelor of Engineering (B.E.) degree. The Electrical Engineering program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org. It is a rigorous four-year program that provides thorough training in the fundamentals of electrical engineering during the first two years. Beginning in the third year, students may also choose to specialize in either microelectronics or telecommunications. The program culminates in the fourth year in an original design project, working on a team with other students and under the supervision of a faculty member. All students are assigned a faculty advisor who consults with them on course selection, academic progress, and career preparation. Throughout their program, the students work in state-of-the-art instructional laboratories that include computer-aided circuit design, lasers, machine vision and computer graphics, microprocessor systems design, microwave electronics, digital signal processing and the most up to date electronic communications.

Electrical engineers are recruited for a variety of fields including energy, aeronautics, communications, testing laboratories, computer technology of hardware and software, and systems for finance and banking. For example, a communications engineer may work on improving communications networks, designing efficient systems for commercial applications, tactical and traffic control systems, or satellite surveillance systems. A circuit design engineer may design, develop, and manufacture electronic circuits for a variety of applications including microcomputers. Stony Brook electrical engineering students may work as interns in engineering and high-technology industries where they can apply their classroom and laboratory knowledge to real-world practice, gaining those skills as preparation for their careers. Upon graduation they are employed by companies in the New York region and across the nation including BAE Systems, Northrop Grumman, Omnicon Group, GE Energy, Motorola, Boeing, and Ford Motors. Many students also choose to continue to pursue graduate degrees in engineering, business, law or medicine.

Program Educational Objectives

The electrical 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, and an 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](http://www.ece.sunysb.edu/peos)

**Requirements for the Major and Minor in Electrical Engineering (ESE)**

**Acceptance into the Major**

Qualified freshman and transfer students who have indicated their interest in the major on their applications may be admitted directly as a degree major or as a pre-major. Pre-majors are placed into the Area of Interest (AOI) program and to be eligible for the degree, they must be admitted to and declare the major. The requirements and application process for matriculation are detailed below. Students admitted to other programs within the College of Engineering and Applied Science (CEAS) follow the same admissions process as students in the AOI program. Students in programs outside of CEAS (non-CEAS students) and double major applicants may apply for admission to the degree program following a separate process, outlined below.

**Area of Interest and Other CEAS Students (excluding double major applicants)**

Applications for major admission from AOI and other CEAS students are reviewed twice per year and must be received by January 5 for Spring admission and June 5 for Fall admission. Students who submit their application on time will be admitted if they meet the following requirements:

- Completion of at least 11 credits of mathematics, physics, and electrical and computer engineering courses required for major (excluding ESE300 and ESE301),
- Earned a G.P.A. of 3.2 or higher in all mathematics, physics, and engineering courses (excluding ESE300 and ESE301) applicable to major requirements with no more than one grade less than B-,
- No courses required for the major have been repeated, and
- Completion of course evaluations for all transferred courses that are to be used to meet requirements of the major.

Students must complete these requirements no later than one year after they enroll in the first course that applies towards major entry. Students must apply for admission by the application deadline immediately following completion of the above requirements, but no later than the one year limit. Admission of AOI students and other CEAS students who apply late will follow the process of Non-CEAS Students and Double Major Applicants below.

**Non-CEAS Students and Double Major Applicants**

Applications for major admission from non-CEAS students and double major applicants are reviewed twice per year and must be received by January 5 for Spring admission and June 5 for Fall admission. Students who do not meet the requirements for AOI admission above will not be considered. Fulfilling the requirements does not guarantee acceptance. Admission is competitive and contingent upon program capacity.

**Requirements for the Major**

The curriculum begins with a focus on basic mathematics and natural sciences followed by courses that emphasize engineering science and bridging courses that combine engineering science and design. The series of courses culminates in a one-year design experience that integrates various engineering skills and knowledge acquired. Technical elective courses are also required according to the student's chosen specialization. The core sequence, technical electives, and additional courses may be chosen in consultation with a faculty advisor, taking into consideration the particular interest of the student.

Completion of the major requires approximately 100 credits.

1. **Mathematics**

- AMS 151, AMS 161 Applied Calculus I, II
- AMS 261 or MAT 203 Applied Calculus III or MAT 205 Calculus III
- AMS 361 or MAT 303 Applied Calculus IV
- AMS 210 or MAT 211 Linear Algebra

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), (MAT 125, MAT 126, and MAT 127) or (MAT 141 and MAT 142), or (MAT 141 and MAT 171).
2. Natural Sciences & Mathematics
   • 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.)
   • 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 301.

3. Freshman Introduction to Electrical Engineering
   • ESE 123 Introduction to Electrical and Computer Engineering
   • ESE 124 Programming Fundamentals

4. Core Courses
   • ESE 118 Digital Logic Design
   • ESE 211 Electronics Lab A
   • ESE 224 Computer Techniques for Electronic Design II
   • ESE 231 Introduction to Semiconductor Devices
   • ESE 271 Electrical Circuit Analysis
   • ESE 280 Embedded Microcontroller Systems Design I
   • ESE 305 Deterministic Signals and Systems
   • ESE 306 Random Signals and Systems
   • ESE 314 Electronics Laboratory B
   • ESE 319 Introduction to Electromagnetic Fields and Waves
   • ESE 324 Electronics Laboratory C
   • ESE 337 Digital Signal Processing Theory
   • ESE 372 Electronics

5. Specializations
   Students must select the general track or one of the two specializations by the end of the sophomore year.
   a. General
      • 4 ESE electives (any 300-level ESE course not required for the major or ESE 476)
      • 2 Technical Electives (See Appendix A in EE Guide)
   b. Microelectronics
      • ESE 311 Analog Integrated Circuits
      • ESE 330 Integrated Electronics
      • 2 Technical Electives (See Appendix A in EE Guide)
      • 2 ESE electives (See Appendix A in EE Guide) (must be selected from ESE 304, 325, 345, 355, 366, 381, or 382)
   c. Telecommunications
      • ESE 340 Basic Communication Theory
      • ESE 342 Digital Communications Systems
      • 2 Technical Electives (See Appendix A in EE Guide)
      • 2 ESE electives (must be selected from ESE 346, 347, 360)

Note: Students should visit the Department of Electrical and Computer Engineering for a copy of a sample course sequence for each specialization.

6. Design
   • ESE 440 and ESE 441, Senior Design I and II

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

7. 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 Electrical Engineering majors. Students must register for the writing course ESE 300 concurrently with or after completion of ESE 280, ESE 314, ESE 324, or ESE 382. Students whose writing does not meet the required standard are referred for remedial help. Detailed guidelines are provided by the Department.

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

Grading

All courses taken for the major must be taken for a letter grade. A grade of C or higher is required in the following courses:

1. ESE 118, ESE 211, ESE 231, ESE 271, ESE 300, ESE 301, ESE 337, ESE 372, ESE 440, ESE 441, AMS 151, AMS 161 (or MAT 131, MAT 132), PHY 131, PHY 132, PHY 133, PHY 134
2. For students in the Microelectronics Specialization: ESE 311, ESE 330, 2 ESE Electives, 1 Technical Elective
3. For students in the Telecommunications Specialization: ESE 340, ESE 342, 2 ESE Electives, 1 Technical Elective
4. For students in the General Track: Four ESE Technical Electives and one technical electives.

Honors Program in Electrical Engineering

The purpose of the honors program in Electrical 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 Electrical 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 Electrical 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.
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 ESE 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./M.S. degrees

The intent of the accelerated five-year Bachelor of Engineering and Master of Science in Electrical Engineering (or Computer Engineering) program is to prepare high-achieving and highly-motivated undergraduate electrical engineering students for either doctoral studies or a variety of advanced professional positions. Electrical 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 (at least a major g.p.a. of 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.

Requirements for the Minor

The Electrical Engineering minor is intended for students with majors other than Electrical or Computer Engineering who seek to complement their chosen major through an introduction to the principles and techniques of electrical engineering. Students interested in the minor should apply through the office of the Department of Electrical and Computer Engineering, as early as possible. A cumulative grade point average of 2.75 is required for admission to the minor.

At least nine credits must be in upper-division courses. All courses for the minor must be passed with a letter grade of C or higher.

Completion of the minor requires 20 credits.

1. ESE 123 (4 credits)
2. ESE 271 (3 credits)
3. Four or five ESE courses for a total of at least 13 credits.

Note: Students may not take ESE 111, ESE 121, ESE 122, ESE 124, ESE 201, ESE 300, ESE 301, ESE 324, ESE 440, ESE 441, ESE 475, ESE 476, ESE 488, or ESE 499 for credit toward the minor.

Sample Course Sequence for the Major in Electrical Engineering, General Track

A course planning guide for this major may be found here. The major course planning guides are not part of the official Undergraduate Bulletin, and are only updated periodically for use as an advising tool. The Undergraduate Bulletin supersedes any errors or omissions in the major course planning guides.

---------------------------------- ALL SPECIALIZATIONS -----------------------------------

FRESHMAN
### Fall 2019 Bulletin

#### First Year Seminar 101
- Credits: 1

#### WRT 102 (WRT)
- Credits: 3

#### AMS 151 or MAT 131 (QPS)
- Credits: 3-4

#### PHY 131/133 (SNW)
- Credits: 4

#### ESE 123 (TECH)
- Credits: 4

#### Total Credits: 15-16

#### Spring

#### First Year Seminar 102
- Credits: 1

#### AMS 161 or MAT 132 (QPS)
- Credits: 3-4

#### PHY 132/134 (SNW)
- Credits: 4

#### ESE 118
- Credits: 4

#### ESE 124
- Credits: 4

#### Total Credits: 16-17

#### Sophomore

#### Fall

#### AMS 361 (or MAT 303)
- Credits: 4

#### AMS 210
- Credits: 3

#### ESE 271
- Credits: 3

#### ESE 305
- Credits: 3

#### ESE 224
- Credits: 3

#### Total Credits: 16

#### Spring

#### AMS 261 (or MAT 203)
- Credits: 4

#### ESE 372
- Credits: 4

#### ESE 306
- Credits: 4

#### ESE 231
- Credits: 3

#### ESE 211
- Credits: 2

#### Total Credits: 17

#### Junior

#### General Track

#### Fall

#### ESE 280
- Credits: 4

#### ESE 314
- Credits: 3

#### ESE 319
- Credits: 3

#### ESE 337
- Credits: 3

#### Math or Science Elective
- Credits: 4

#### Total Credits: 17
### SPRING

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#### SPRING

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General, Microelectronics and telecommunications Specialization:

All courses in **bold** must be passed with a minimum grade of C.

1. AMS 151 and AMS 161 can be replaced by (MAT 131 and MAT 132) or (MAT 131 and 171), or (MAT 125, MAT 126, and MAT 127) or (MAT 141 and MAT 142), or (MAT 141 and MAT 171).
2. PHY 131 and PHY 132 can be replaced by (PHY 125, PHY 126, and PHY 127), or (PHY 141 and PHY 142). Students taking the three semester sequence should take PHY 125, PHY 127 and PHY 126 in that order.
3. General ---Choice of four 300 – level ESE electives that are not required courses, ESE 476 may also be used. 2 Technical Electives (See Appendix A in EE Guide)
   Microelectronics -- Choice of two 300—level ESE electives that are not required, ESE 476 may also be used. (must be selected from ESE 304, 325, 345, 355, 366, or 382)
   Telecommunications -- Choice of two 300—level ESE electives that are not required, ESE 476 may also be used. (must be selected from ESE 346, 347, 360)
4. Two courses selected from Appendix A.
5. Math or science elective: One 4- credit course or two 3 – credit courses from CHE 131, BIO 202 & 204, BIO 203 & 205, ESG 198, PHY 251 & 252, AMS 301

* Note: This course partially satisfies the following: ESI, CER, SPK, WRTD, SBS+, STEM+, EXP+. For more information contact the CEAS Undergraduate Student Office.
**ESE Engineering**

**ESE 111: Making with Arduino: Hardware and Programming**
Create a working electronic project using low-cost and easy-to-program Arduino development boards. Example projects may include wearable electronics, robots, and electronic displays. An introduction to the C programming language will be provided along with the basics of embedded electronics and the Internet of Things.

**SBC:** TECH

3 credits

**ESE 118: Digital Logic 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:** ESE 123

**SBC:** TECH

4 credits

**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 122: Discrete Mathematics for Engineers**
Introduction to topics in computational mathematics, such as number systems, Boolean algebra, mathematical induction, combinatorics and probability, recursion and graph theory. Algorithm aspects of the topics discussed will be emphasized.

**Corequisite:** ESE 123

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. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

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

**SBC:** TECH

4 credits

**ESE 124: Programming Fundamentals**
The course presents fundamental and more advanced C programming concepts. Lectures discuss the C language constructs and exemplify their use in relevant programming applications. The course also introduces fundamental concepts in electrical and computer engineering, such as bitwise operations, text file scanning, stack-based computation, table-based finite state machine implementation, hash tables, and linked lists. Scheduled lab activities focus on devising, implementing, debugging, and validating C programs for the concepts discussed in class. A course project focuses on developing a more extensive C program that comprehensively utilizes the programming concepts discussed during the semester.

**Prerequisite:** Declared Area of Interest or Major in Electrical or Computer Engineering.

4 credits

**ESE 188: Understanding Machine Learning**
This is a course on the basics of machine learning. Students develop an intuitive understanding of the core concepts of machine learning including supervised and unsupervised learning, classification and prediction. The course provides a number of practical examples from a wide range of disciplines including biomedicine, social sciences, and engineering. The course does not require any prerequisites in engineering or computer science.

**SBC:** TECH

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 ESE 127 or ESE 131 or ESE 141 or EST 194 or EST 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, waveform shaping circuits, and basic switching circuits.

**Prerequisite:** ESE 271

Corequisite: ESE 372

2 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 Analog Circuits**
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
Prerequisite: MAT 127 or 132 or 142 or 171 or AMS 161  
Pre/co-requisite: PHY 127/134 or 132/134 or 142  
3 credits

ESE 280: Embedded Microcontroller Systems Design I
Fundamental design of microcontroller-based electronic systems. Topics include system level architecture, microcontrollers, memory, configurable ports, peripheral ICs, interrupts, sensors, and actuators, serial data protocols, assembly language programming, debugging, and table driven FSMs. Hardware/software trade-offs in implementing system functions. Hardware and software design are equally emphasized. Laboratory work involves design, implementation, and verification of microcontroller systems. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.  
Prerequisite: ESE or ECE major; ESE 118 or permission of instructor.  
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 differs 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 queueing 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 312: Lightwave Devices
Introduction to optical semiconductor devices and their applications in telecommunications, optoelectronics, and consumer electronics-areas where signal processing or the transmission of signals across free space or fiber optic cables is involved. It discusses design and operation of optical modulators, quantum well lasers, light emitting diodes, and photodetectors.  
Prerequisite: ESE 231  
3 credits

ESE 313: Introduction to Photovoltaics
Introduction to the basic concepts of photovoltaic solar energy conversion, including: 1. The solar resource in the context of global energy demand; 2. The operating principles and theoretical limits of photovoltaic devices; 3. Device fabrication, architecture, and primary challenges and practical limitations for the major technologies and materials used for photovoltaic devices. Students will gain knowledge of: the device physics of solar cells, the operating principles of the major commercial photovoltaic technologies, the current challenges and primary areas of research within the field of photovoltaics, and a basic understanding of the role of photovoltaics in the context of the global energy system.  
Prerequisite: ESE 231 or ESG 281 or permission of instructor  
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. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

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 323: Modern Circuit Board Design and Prototyping
Design, fabricate, and test a prototype device using a custom made circuit board, surface mount components, and a 3D printed enclosure. Topics include printed circuit design, active and passive component selection, design for testability, solid modeling, and 3D printing.

Prerequisite: ESE 211 and ESE 380
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. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

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 342: Digital Communications Systems

Prerequisite: ESE 340
3 credits

ESE 343: Mobile Cloud Computing
Introduction to the basic concepts of mobile cloud computing, including: 1. The mobile computing technology used in modern smart phones; 2. The cloud computing technology used in existing data centers; 3. The synergy of mobile and cloud computing and its applications; 4. Programming on smart phone utilizing data center services. Students will gain knowledge of: the fundamental principles of mobile cloud computing, the major technologies that support mobile cloud computing, the current challenges and primary areas of research within the field of mobile cloud computing, and a basic understanding of the role of mobile cloud computing in the context of everyday living.

Prerequisite: ESE 224, CSE 214, CSE 230 or ISE 208
3 credits

ESE 344: Software Techniques for Engineers
This course covers software techniques for solving electrical and computer engineering problems in the C++ programming language. Design, implementation, and application to engineering problems of non-linear data structures and related advanced algorithms are covered. This includes binary trees, trees,
graphs, and networks. OOP features such as Polymorphism, templates, Exception handling, File I/O operations, as well as Standard Template Library are used in the programming projects.

Prerequisites: ESE 224
3 credits

ESE 345: Computer Architecture
This course focuses on the fundamental techniques of designing and evaluating modern computer architectures and tradeoffs present at the hardware/software boundary. The emphasis is on instruction set design, processor design, memory and parallel processing. Students will get an understanding of the design process in the context of a complex computer system. Students will undertake a VHDL/Verilog design project using modern CAD tools.

Prerequisites: ESE 280 and ESE 382
3 credits

ESE 346: Computer Communications
Basic theory and technology of computer communications. Introduction to performance evaluation, error codes and routing algorithms. Other topics include Ethernet, wireless networks including LTE and 5G, fiber optic networking, software defined networking, networking on chips, space networks, data centers, grids and clouds, and network security. Not for credit in addition to CSE 310 or ISE 316. 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 performance analysis. Includes extensive laboratory experiments and hands-on use of CAD tools.

Prerequisite: ESE 218
4 credits

ESE 356: Digital 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, computational techniques, and applications in visual information processing. Covers image formation models and image filtering, binary image analysis, feature detection, contours, image segmentation, 3D image capture and analysis through stereo, motion, structured-light, and LIDAR, medical images, pattern classification, machine learning, and 3D object recognition.

Prerequisites: ESE 305; ESE 224 or CSE 230
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.

Pre- or corequisite: ESE/CSE 346 or CSE/ISE 310
3 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 waveform shaping circuits.

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

ESE 375: Architectures for Digital Signal Processing
This course covers various aspects of architectures in digital signal processing and multimedia data processing. The topics include iteration bound analysis, retiming the circuits, unfolding and folding the architectures, algorithmic and numerical strength reduction for low power and low complexity design, introduction to array processor architectures and CORDIC implementation.

Prerequisites: ESE 280 and ESE 305
3 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: Senior Design I**

The senior design sequence (ESE 440 and ESE 441) is a two-semester, team based and independent capstone project with deliverables. The primary objective of the senior design course sequence is to provide a vehicle for students to transition from an academic environment to that of a commercial/professional engineering environment. Students learn to work in teams to complete a project from concept, practical design based on multiple constraints, to creating a deliverable product meeting the design specifications. Students present written, oral and poster presentations of the project. While most of the project work is done outside the classroom, guest speakers provide insight into other related topics from resume preparation, to program management, to team dynamics and to design methodologies used in industry. The project incorporates appropriate engineering standards and multiple realistic constraints. Not counted as a technical elective. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

**Prerequisite:** ESE 440

3 credits

**ESE 441: Senior Design II**

The senior design sequence (ESE 440 and ESE 441) is a two-semester, team based and independent capstone project with deliverables. The primary objective of the senior design course sequence is to provide a vehicle for students to transition from an academic environment to that of a commercial/professional engineering environment. Students learn to work in teams to complete a project from concept, practical design based on multiple constraints, to creating a deliverable product meeting the design specifications. Students present written, oral and poster presentations of the project. While most of the project work is done outside the classroom, guest speakers provide insight into other related topics from resume preparation, to program management, to team dynamics and to design methodologies used in industry. The project incorporates appropriate engineering standards and multiple realistic constraints. Not counted as a technical elective. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

**Prerequisites:** ESE or ECE major; U4 standing; ESE 300; For ESE majors: ESE 324 and two technical electives or for ECE majors: two ECE technical electives.

3 credits

**ESE 457: Fundamentals of Digital Image Processing**

This course covers fundamentals of digital image processing. Basic principles, computational algorithms, and applications are covered. Topics include image formation and sensing, sampling and quantization, image enhancement and histogram analysis, geometric transformations, filtering in the spatial and Fourier domains, edge and feature detection, color image processing, image deblurring, and medical images and computed tomography.

**Prerequisites:** ESE 305; ESE 224

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; a minimum g.p.a. of 3.00 in all Stony Brook courses, and a grade of B or better in the course in which the student is to assist; permission of department.

**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.

**Prerequisites:** ESE 494, permission of department and acceptance into the ECE or ESE Honors programs
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