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, Omnicom 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

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

Acceptance into the Major

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

1. The student has completed at least 11 credits of mathematics, physics, or electrical and computer engineering courses required for the major
2. The student has earned a grade point average of 3.00 or higher in these course
3. No courses required for the major have been repeated
4. All transfer courses have been evaluated.

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
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), or (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 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, CHE 141, 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 Computer Techniques for Electronic Design I

4. Core Courses
ESE 211 Electronics Lab A
ESE 218 Digital Systems Design
ESE 224 Computer Techniques for Electronic Design II
ESE 231 Introduction to Semiconductor Devices
ESE 271 Electrical Circuit Analysis
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  
ESE 380 Embedded Microprocessor Systems Design I  

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, 307, 325, 345, 355, 366, 373, or 381)  
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 321, 323, 341, 346, 347, 360, or 363)  
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, Engineering 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 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.  

8. Engineering Ethics  
ESE 301 Engineering Ethics and Societal Impact (DEC H)  

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 211, ESE 218, ESE 231, ESE 271, ESE 300, ESE 337, ESE 372, AMS 151, AMS 161 (or MAT 131, MAT 132), PHY 131, PHY 132  
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 elective.  

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.  

Students seeking to complete the ESE minor must meet the relevant prerequisites and corequisites of each ESE course.  

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 21 credits.  

1. ESE 123 (4 credits)
2. ESE 271 (4 credits)
3. Four or five ESE courses for a total of at least 13 credits.
Note: Students may not take ESE 124, ESE 275, ESE 300, ESE 324, ESE 440, ESE 441, ESE 475, ESE 476, ESE 488, or ESE 499 for credit toward the minor.

**Sample Course Sequences for the Major in Electrical Engineering**

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

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-------------- TELECOMMUNICATIONS SPECIALIZATION ---------------

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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, 307, 325, 345, 355, 366, 373, or 381)Telecommunications -- Choice of two 300—level ESE electives that are not required, ESE 476 may also be used. (must be selected from ESE 321, 323, 341, 346, 347, 360, or 363)
4- Two courses selected from Appendix A.
5- Math or science elective: One 4-credit course or two 3-credit courses from CHE 131, CHE 141, ESG 198, BIO 202& 204, BIO 203& 205, PHY 251&252, AMS 301
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.
Prerequisite: BME 100 or CME 101 or ESG technology to create a new product or service.
operational process, or in the application of either a significant technical advance in an where the business concept is built around proactiveness. The course focuses on ventures around innovativeness, risk-taking and the necessary exposure to the fundamentals from the engineering disciplines to computer background, but have some background not expected to have any formal business entrepreneurial proficiency. Students are gap between technical competence and The purpose of this course is to bridge the EST 194 or EST 202 or LSE 320
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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 discreet 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 211 and 372
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. 

Prerequisite: ESE 340

3 credits

**ESE 342: Digital Communications Systems**


Prerequisites: 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/ISE 310. This course is offered as both CSE 346 and ESE 346. 

Prerequisite for CSE and ECE majors: ESE 306

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 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 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 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 wave-shaping 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 218

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 218

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; 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.

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

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

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*