Electrical Engineering (ESE)
Major and Minor in Electrical Engineering

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

CHAIRPERSON: Serge Luryi
UNDERGRADUATE PROGRAM DIRECTOR: Ridha Kamoua
SENIOR STAFF ASSISTANT: Carolyn Huggins

OFFICE: 267 Light Engineering
PHONE: (631) 632-8415
E-MAIL: postmaster@ece.sunysb.edu
WEB ADDRESS: http://www.ece.sunysb.edu

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](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 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

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 Sequential B.E./M.S. degrees
The intent of the sequential 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 sequential 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 sequential program is as rigorous as the current B.E. and M.S. programs taken separately. The requirements for the sequential 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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----------------------------- MICROELECTRONICS SPECIALIZATION -----------------------------
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<td>ESE 337</td>
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**Total** 16

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<td>ESE 324</td>
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<td>ESE 301 (H)</td>
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**Total** 17

### Senior Fall Credits

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**Total** 16

### Senior Spring Credits

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**Total** 17

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### TELECOMMUNICATIONS SPECIALIZATION

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</table>

**Total** 16

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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

Electrical Engineering

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
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 or 132/134 or 142 or ESE 124
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 or 132/134 or 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 or 132/134 or 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 - H: 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.
Prerequisites: U3 or U4 standing, one D.E.C. category E course
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
operative 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 307: Analog Filter Design
Introduces basic concepts of analog filter theory and implementation. Topics include: filter types; transfer functions; Bode plots; implementation of first- and second-order filters using op amps, maximally flat, and equal-ripple filters; frequency transformations; LC ladders; transconductance-C realizations; switched capacitor circuits; and filter sensitivity.

Prerequisites: ESE 305 and 372
3 credits

ESE 310: Electrical Circuit Analysis II
Network elements, graph theory, linear network analysis; fundamental loops and cutsets, matrix solutions, nonlinear network analysis; state variables, small and large signal analysis, numerical methods.

Prerequisite: ESE 271
3 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 211 and 372

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 321: Electromagnetic Waves and Wireless Communication
Covers the wireless radio signal environment; electromagnetic wave propagation in free space and in other media; effects of reflection, scattering, diffraction, and multi-path interference on the characteristics and quality of the received signal; cellular wireless network planning; efficient use and reuse of assigned radio frequency spectrum; effects of transmitting and receiving antenna design; introduction of basic wireless communication techniques to achieve reliable communication.

Prerequisite: ESE 319
3 credits

ESE 322: Introduction to Auto ID Technologies
Introduces theory and application of important data-capture technologies namely barcodes, biometrics and RFID. Topics to be covered include: architecture of data-capture / Auto ID systems, barcodes; overview of 1-D and 2-D barcodes and other LOS technologies biometrics; fingerprints, iris-scan, voice recognition and smart-cards; radio frequency identification (RFID); fundamentals, near-field vs. far field, UHF read range estimation, reader sensitivity limits, tag singulation and multiple access protocols, standards, privacy and security issues in RFID, real time location systems (RTLS).

Prerequisites: ESE 218, 305, and 372; Corequisite: ESE 319
3 credits

ESE 323: RFID Technology for Automatic Identification
This course covers the analysis and design of RFID technologies for automatic identification. Included are the theory of operation, analysis of RFID system components, passive and active tags, frequencies used, air interfaces, coding structures, antenna design, and regulatory compliance.

Prerequisite: ESE 319
3 credits

ESE 324: Electronics Laboratory C
Illustrates and expands upon advanced concepts presented in ESE 372. Experiments include multistage amplifiers, class B and class C power amplifiers, speech processing, active RC and switched-capacitor filters, oscillators,
and switching power supplies. 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 332: Semiconductor Device Characterization**
Basic experimental experience in characterization of microelectronic and optoelectronic semiconductor devices including diodes, transistors, light emitting diodes, lasers, and photodetectors. Measurement of I-V and L-I (light-current) device characteristics; practice in the techniques of determining various device parameters; analysis of aggregate experimental data to determine the relationships between device and output characteristics, device band diagrams, and device design. Includes study of modern methods of silicon and compound semiconductor devices and systems technologies.

**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**

**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/ISE 310. This course is offered as both ESE 346 and ESE 347.

**Pre- or corequisite for ESE and ECE majors:** ESE 346

**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 306

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
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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 271

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: 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 357: Digital Image Processing**

Covers digital fundamentals, image transforms, image enhancement, image restoration, image compression, segmentation, representation and description, recognition and interpretation.

**Prerequisites for ESE and ECE majors:** ESE 305; ESE 224 or CSE 230

**Prerequisites for CSE majors:** CSE 214 and 220

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 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. 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. 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