

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)

The Department of Electrical and Computer Engineering offers two majors leading to the Bachelor of Engineering (B.E.) degree. The Department's teaching and research areas computer engineering, computer networks, microprocessors, computer architecture, communications, signal and image processing, pattern recognition, electronic circuits, solid-state electronics, lasers and fiber-optics, electromagnetics, microwave electronics, systems and control, biomedical engineering, VLSI, computer-aided design, parallel and distributed processing, computer vision, and computer graphics. The Electrical Engineering program is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD, 21202-4012 – telephone: (410)347-7700.

The objective of the Electrical and Computer Engineering programs is to give students an excellent preparation for professional careers or graduate studies in the electrical and computer engineering fields. The programs provide students with depth and breadth of knowledge in engineering science and engineering design as well as in mathematics and the natural sciences. Development of non-technical skills such as communication and teamwork is also emphasized. The curriculum of the two programs is shared in the freshman year and diverges in the sophomore year. Electrical Engineering students may choose a specialization which is completed in the junior and senior years. See the Computer Engineering entry in the alphabetical listing of Approved Majors, Minors, and Programs for the requirements for that major.

Program Educational Objectives

The undergraduate program in electrical engineering has the following five specific program educational objectives (PEOs):

1. Graduates should excel in engineering positions in industry and other organizations that emphasize design and implementation of engineering systems and devices.
2. Graduates should excel in the best graduate schools, reaching advanced degrees in engineering and related disciplines.
3. Within several years from graduation our alumni should have established a successful career in an engineering-related multidisciplinary field, possibly leading or participating effectively in interdisciplinary engineering projects, as well as continuously adapting to changing technologies.
4. We expect our graduates to continue personal development through professional study and self-learning.
5. We expect our graduates to be good citizens and cultured human beings, as well as to appreciate the importance of professional, ethical, and societal responsibilities.

Program 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>

Following graduation many students choose immediate employment in industry from Long Island to the West Coast. Electrical and computer engineers are recruited in diverse fields for a variety of challenging positions: a communications engineer may work on improving the flow of traffic in communications networks; a command and control engineer may work on systems in tactical and traffic control, satellite and surveillance systems, or in commercial applications; a circuit design engineer designs, develops, and manufactures electronic circuits for many applications including microcomputers; and computer engineers design microprocessor-based systems that include a range of consumer products, industrial machinery, and specialized systems such as those used in flight control, automobiles, and in financial institutions. Graduates also pursue advanced degrees in engineering, business, finance, medicine, law, and other professions in which their problem-solving skills and technical knowledge are valuable qualities.

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 only 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 125, MAT 126, MAT 127
 or MAT 131, MAT 132
 or MAT 141, MAT 142
 or MAT 171

2. Natural Sciences

PHY 131/PHY 133, PHY 132/PHY 134 Classical Physics I, II and Laboratories
 CHE 131 General Chemistry I

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.) The chemistry course CHE 141 or ESG 198 are accepted in lieu of CHE 131.

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)

b. Microelectronics

ESE 311 Analog Integrated Circuits
 ESE 330 Integrated Electronics
 2 Technical Electives
 2 ESE electives (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
 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 400 and ESE 441, Engineering Design I and II. Students who select the Microelectronics or Telecommunications specialization must complete a senior design project designated for the relevant area.

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 304, ESE 311, ESE 330, ESE 355, ESE 373
3. For students in the Telecommunications Specialization: ESE 340, ESE 342, ESE 346, ESE 347, ESE 363
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 -----

Freshman Fall	Credits	Freshman Spring	Credits
First Year Seminar 101		1 First Year Seminar 102	1
AMS 151 (or MAT 131)#	3-4	AMS 161 (or MAT 132)	3-4
PHY 131/PHY 133#		PHY 132/PHY 134#	4
ESE 123		ESE 124	3
D.E.C. A#		CHE 131	4
Total	15-16	Total	15-16

Sophomore Fall	Credits	Sophomore Spring	Credits
AMS 361 (or MAT 303)		AMS 261 (or MAT 203)	4
ESE 218#		ESE 372#	4
ESE 224		ESE 306	4
ESE 271#		ESE 231#	3
ESE 305		ESE 211#	2
Total	18	Total	17

----- GENERAL TRACK -----

Junior Fall	Credits	Junior Spring	Credits
AMS 210 (or MAT 211)		ESE xxx#	3
ESE 314		ESE xxx#	3
ESE 319		ESE 324	2
ESE 337#		ESE 300#	3
D.E.C.		D.E.C.	3
		ESE 301 (D.E.C. H)	3
Total	15	Total	17

Senior Fall	Credits	Senior Spring	Credits
ESE 440		ESE 441	3
ESE xxx#		ESE xxx#	3
ESE 380		Technical elective#	3
Technical elective		D.E.C.	3
D.E.C.		D.E.C.	3
Total	16	Total	15

----- MICROELECTRONICS SPECIALIZATION -----

Junior Fall	Credits	Junior Spring	Credits
AMS 210 (or MAT 211)	3	ESE xxx*	3
ESE 314	3	ESE 324	2
ESE 319	3	ESE 300	3
ESE 337#	3	ESE 311#	3
ESE 330#	3	ESE 301 (H)	3
D.E.C.	3	D.E.C.	3
Total	18	Total	17

Senior Fall	Credits	Senior Spring	Credits
ESE 440	3	ESE 441	3
ESE xxx*	3	Technical elective	3
ESE 380	4	Technical elective	3
D.E.C.	3	D.E.C.	3
D.E.C.	3	D.E.C.	3
Total	16	Total	15

----- **TELECOMMUNICATIONS SPECIALIZATION** -----

Junior Fall	Credits	Junior Spring	Credits
AMS 210 (or MAT 211)	3	ESE xxx*	3
ESE 314	3	ESE 324	2
ESE 319	3	ESE 300	3
ESE 337	3	ESE 342	3
ESE 340	3	ESE 301 (D.E.C. H)	3
		D.E.C.	3
Total	15	Total	17

Senior Fall	Credits	Senior Spring	Credits
ESE 440	3	ESE 441	3
ESE 380	4	Technical Elective	3
ESE xxx	3	Technical Elective	3
D.E.C.	3	D.E.C.	3
D.E.C.	3	D.E.C.	3
Total	16	Total	15

Microelectronics Specialization only:

Total number of credits=128-130

*2 ESE electives must be selected from ESE 304, ESE 307, ESE 325, ESE 345, ESE 355, ESE 366, ESE 373, ESE 381

D.E.C.=Diversified Education Curriculum (General Education Curriculum)

Courses in bold must be passed with a minimum grade of C

Telecommunications Specialization only:

Total number of credits=128-130

*2 ESE electives must be selected from ESE 321, ESE 323, ESE 341, ESE 346, ESE 347, ESE 360, ESE 363

D.E.C.=Diversified Education Curriculum (General Education Curriculum)

Courses in bold must be passed with a minimum grade of C

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 for ESE and ECE majors: 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 for engineering majors: PHY 127 or 132/134 or 142 or ESE 124

Prerequisite for computer science majors: CSE 220

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 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

Introduction to signals and systems. Manipulation of simple analog and digital signals. Relationship between frequencies of analog signals and their sampled sequences. Sampling theorem. Concepts of linearity, time-invariance, causality in systems. Convolution integral and summation; FIR and IIR digital filters. Differential and difference equations. Laplace transform, Z-transform, Fourier series and Fourier transform. Stability, frequency response and filtering. Provides general background for subsequent courses in control, communication, electronics, and digital signal processing.

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

Coordinated with, and illustrates and expands upon, concepts presented in ESE 372. Experiments include diode circuits, class A BJT, FET and differential amplifiers as well as analog signal processing. Laboratory fee required.

Prerequisites: ESE 211 and 372

3 credits

ESE 315: Control System Design

Analysis and design of linear control systems. Control components, development of block diagrams. Computer simulation of control systems and op-amp circuit implementation of compensators. Physical constraints in the design. Pole-placement and model matching design using linear algebraic method. Selection of models using computer simulation and quadratic optimal method. Root-locus method and Bode plot method. Use of PID controllers in practice.

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 designs. 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

Pulse modulation and sampling. All-digital networks. Pulse code modulation. Digital modulation techniques. Time-division multiplexing. Baseband signaling. Intersymbol interference. Equalization. Basic error control coding. Exchange of reliability for rate. ARQ schemes. Message and circuit switching.

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 CSE 346 and ESE 346.

Pre- or corequisite for ESE and ECE majors: ESE 306

Pre- or corequisite for CSE majors: AMS 310 or 311

3 credits

ESE 347: Digital Signal Processing: Implementation

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

Prerequisites: ESE 337, or ESE 305 and 380

4 credits

ESE 350: Electrical Power Systems

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

Prerequisite: ESE 271

3 credits

ESE 352: Electromechanical Energy Converters

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

Prerequisite: ESE 372

3 credits

ESE 355: VLSI System Design

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

Prerequisite: ESE 218

4 credits

ESE 356: 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