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.

**ESE 201: Engineering and Technology Entrepreneurship**

The purpose of this course is to bridge the gap between technical competence and entrepreneurial proficiency. Students are expected of all electrical engineering students in subsequent courses in the major.

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

**SBC**: TECH

3 credits
ESE 301: Engineering Ethics and Societal Impact
The study of ethical issues facing engineers and engineering related organizations and the societal impact of technology. Decisions involving moral conduct, character, ideals and relationships of people and organizations involved in technology, the interaction of engineers, their technology, the society and the environment is examined using case studies.
Pre- or Corequisite: ESE 305
3 credits

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

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

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

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

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

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

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

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

ESE 323: Modern Circuit Board Design and Prototyping
Design, fabricate, and test a prototype device using a custom made circuit board, surface mount components, and a 3D printed enclosure. Topics include printed circuit design, active and passive component selection, design for testability, solid modeling, and 3D printing.
Prerequisite: ESE 211 and ESE 380
3 credits

ESE 324: Electronics Laboratory C
Illustrates and expands upon advanced concepts presented in ESE 372. Experiments include analog circuits such as oscillators, voltage regulators; mixed -signal circuits such as data converters, phase - locked loops, and several experiments emphasizing the analog design issues in digital circuits. Laboratory fee required. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.
Prerequisites: ESE or ECE major; U3 standing; ESE 211 and 372
2 credits

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

Prerequisite: ESE 372
3 credits

**ESE 330: Integrated Electronics**

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

Prerequisite: ESE 372
3 credits

**ESE 333: Real-Time Operating Systems**

Introduces basic concepts and principles of real-time operating systems. Topics include structure, multiple processes, interprocess communication, real-time process scheduling, memory management, virtual memory, file system design, security, protection, and programming environments for real-time systems.

Prerequisites: ESE 124; CSE 214; ESE 380 or CSE 220
3 credits

**ESE 337: Digital Signal Processing: Theory**

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

Prerequisite: ESE 305
3 credits

**ESE 340: Basic Communication Theory**

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

Prerequisites: ESE 305 and 306
3 credits

**ESE 341: Introduction to Wireless and Cellular Communication**

Basic concepts of wireless cellular communications, radio frequency, spectrum re-use, radio channel characterization, path loss and fading, multiple access techniques, spread spectrum systems, channel coding, specific examples of cellular communication systems.

Pre or Co-requisite: ESE 340
3 credits

**ESE 342: Digital Communications Systems**


Prerequisite: ESE 340
3 credits

**ESE 343: Mobile Cloud Computing**

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

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

**ESE 344: Software Techniques for Engineers**

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 include 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
Pre requisite for ESE and ECE majors: ESE 380 and ESE 382
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 316. This course is offered as both CSE 346 and ESE 346.

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

**ESE 347: Digital Signal Processing: Implementation**

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

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

**ESE 350: Electrical Power Systems**

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

Prerequisite: ESE 271
3 credits
ESE 352: Electromechanical Energy Converters
Basic principles of energy conversion; DC, induction, and synchronous rotary converters; the three-phase system and symmetrical components; the relationships between voltage, current, flux, and m.m.f.; equivalent circuits and operating characteristics of rotary converters; and analysis of saturation effects.
Prerequisite: ESE 372
3 credits

ESE 355: VLSI System Design
Introduces techniques and tools for scalable VLSI design and analysis. Emphasis is on physical design and 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 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.
Pre- or corequisite: 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
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 or ECE major; ESE 218 or permission of instructor.
4 credits

ESE 381: Embedded Microprocessor Systems Design II
A continuation of ESE 380. The entire system design cycle, including requirements definition and system specifications, is covered. Topics include real-time requirements, timing, interrupt driven systems, analog data conversion, multi-module and multi-language systems. The interface between high-level language and assembly language is covered. A complete system is designed and prototyped in the laboratory.
Prerequisites: ESE 271 and 380
4 credits

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

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

4 credits

ESE 440: Engineering Design I

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

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

3 credits

ESE 441: Engineering Design II

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

Prerequisite: ESE 440

3 credits

ESE 475: Undergraduate Teaching Practicum

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

Prerequisites: U4 standing; a minimum g.p.a. of 3.0 in all Stony Brook courses, and a grade of B or better in the course in which the student is to assist; permission of department.

SBC: EXP+

3 credits

ESE 476: Instructional Laboratory Development Practicum

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

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

SBC: EXP+

3 credits

ESE 488: Internship in Electrical/Computer Engineering

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

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

SBC: EXP+

3 credits

ESE 494: Honors Seminar on Research

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

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

1 credit

ESE 495: Honors Research Project

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

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

3 credits

ESE 499: Research in Electrical Sciences

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

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

0-3 credits