ESE

Electrical Engineering

ESE 123 Introduction to Electrical and Computer Engineering
Introduces basic electrical and computer engineering concepts to 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 laboratory. 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.
3 credits

ESE 124 Computer Techniques for Electronic Design
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 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.
Corequisites 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 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 161 or MAT 127 or 132 or 142; PHY 127 or 132/134 or 142.
3 credits

ESE 271 Electrical Circuit Analysis I
Kirchhoff’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; PHY 127 or 132/134 or 142.
3 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 Writing in Electrical/Computer Engineering
See requirements for the majors in Electrical Engineering and Computer Engineering, upper-division writing requirement.
Prerequisites: WRT 102; ESE or ECE major, U3 standing.
Pre-or Corequisites: ESE 314 or 324 or 380 or 382.
1 credit, S/U grading.

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 Corequisites: 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.
Prerequisite: ESE 305.
3 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 ladder; transconductance-C realizations; switched capacitors; 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 312 Microwave Electronics
Fundamentals of microwave and RF electronics. Includes S-parameter theory, Smith charts, amplifier and oscillator design, matching network synthesis, large-signal and broadband methods, and power combiners. Computer-aided design packages are used throughout the course.
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
Prerequisite: ESE 271.
3 credits

ESE 316 Digital Devices and Circuits
Switching characteristics of devices: bipolar transistors, MOSFETs, C.C.D.s. Circuit analysis of leading IC gate technologies: TTL, ECL, MOS, CMOS, dynamic MOS. Interfacing logic families. Application of small-scale I.C.s in control and timing circuits. Large-scale integrated circuits; organization and characteristics of RAMs, ROMs and PLAs. The use of computer-aided circuit analysis is included.
Prerequisite: ESE 372.
3 credits

ESE 319 Introduction to Electromagnetic Fields and Waves
Fundamental experimental results of electromagnetism. Topics include: mathematical formulation of integral laws and derivation and physical interpretation of differential Maxwell equations in free space; interaction of electromagnetic sources and fields; engineer-
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 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 I-L (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 Information Theory and Coding
Statistical characteristics of languages, information sources as random processes, measurement of information, noiseless coding; the binary symmetric channel and other digital channels; channel capacity, introduction to algebraic coding theory for noisy channels, communication with feedback.
Prerequisite: ESE 306 or AMS 311.
3 credits

ESE 342 Digital Communications Systems
Prerequisite: ESE 340.
3 credits

ESE 343 Modern Electronic Communications Laboratory
Experimental study of communications systems and components. Design, test, and measurement techniques. AM and FM modulators and demodulators. Spectra, bandwidth measurement, analog and digital signaling equipment. Applications in communication and radar systems.
Prerequisite: ESE 340.
Pre- or Corequisite: ESE 342.
2 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 and CSE 230.
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: ESE 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, metropoli-
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 (or ESG 111 or MEC 111 or ESE 211 or ESE 218) contain specific description when
ESE or ECE major, U4 standing; two
U4 standing; minimum cumulative g.p.a.
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
3 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 circuit boards 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 antennas. Computer simulation using MATLAB 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 microcontroller circuits.
Prerequisite: ESE 218
3 credits
ESE 381 Embedded Microprocessor Systems Design II
A continuation of ESE 380. The entire system design cycle, including requirements definition and system specifications, is covered. Topics include real-time requirements, timing, interrupt driven systems, analog data conversion, multi-module and multi-language systems. The interface between high-level language and assembly language is covered. A complete system is designed and prototyped in the laboratory.
Prerequisites: ESE 271 and 380
3 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 digital 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
3 credits
ESE 390 Special Topics in Digital Systems
A vehicle for new course material of current interest in the area of digital systems. Semester supplements to this Bulletin contain specific description when course is offered. May be repeated for different topics but only three credits may be counted as technical electives.
Prerequisite: Permission of department
1-6 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 390. Students may need additional prerequisites depending on the design project undertaken.
5 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 3.0 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.
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, IE 467) 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.
0-9 credits