**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

**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

**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 211

Corequisite for ESE and ECE majors: ESE 372

**ESE 218 Digital Systems Design**
Develops methods of analysis and design of both combinatorial and sequential systems regarding digital circuits and 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 FLRs 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

**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

**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

**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 or ESE 124 or 171; PHY 127 or 132/134 or 142

**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/she has had the theoretical portion elsewhere. Open elective credit only.

*Prerequisite:* Permission of department

**ESE 300 Technical Communication for Electrical and Computer Engineers**
Topics include how technical writing differs 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 101; ESE or ECE major, U3 standing

*Pre- or Corequisite:* ESE 314 or 324 or 380 or 382

**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

**ESE 305 Deterministic Signals and Systems**

*Pre- or Corequisite:* ESE 271

**ESE 306 Random Signals and Systems**
Random experiments and events; random variables, probability distribution and density functions, continuous and discrete random processes; Gaussian, Bernoulli, Poisson, and Markov 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

**ESE 308 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

**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

**ESE 311 Analog Integrated Circuits**
Designing engineering 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

**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

**ESE 314 Electronics Laboratory B**
Can coordinate with, and illustrates and expands upon, concepts presented in ESE 372. Includes free course credits, class A/BJT, FET and differential amplifiers as well as analog signal processing. Laboratory fee required.

*Prerequisites:* ESE 211 and 372

**ESE 315 Control System Design**

*Prerequisite:* ESE 271

**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 ICs 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

**ESE 319 Introduction to Electromagnetic Fields and Waves**
Fundamental experimental results of electromagnet-
ESE 330 Integrated Electronics
An overview of the design and fabrication of integrated-circuit topics. 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 storage. Emphasizes design of real-time operating systems.
Prerequisites: ESE 124, CSE 214, ESE 380 or CSE 220
3 credits

ESE 337 Digital Signal Processing: Theory
Introduces digital signal processing theory and applications, 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.
Pre- or Corequisite: ESE 340
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
Teaches 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 components. Explores 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 devices 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/ESE 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
Prerequisite for CSE majors: CSE 220
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
3 credits

ESE 349 Introduction to Fault Diagnosis of Digital Systems
A follow-up to ESE 218 to acquaint students with fault diagnosis of logic circuits. Both combinational and sequential circuits are considered. Concepts of faults and fault models are presented followed by discussion of test generation, test selection, and fault dictionaries. Emphasis is on test generation for fault detection, fault location, fault location within a module and fault correction. Some basic reliability-enhancing design techniques for digital circuits and systems are also discussed.
Prerequisite: ESE 218
2 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
ESE 271
ESE 271
ESE 372
ESE 344 or CSE 214
U4 standing; a minimum g.p.a. of 3.00 in
Permission of department
CSE 214 and 220
ESE 271; MEC 301 or ESG 302
46x143
224 or CSE 230

detailed coverage of laser and semiconductor devices
imaging, and optical communication systems. A
including a firm basis of fundamental physics, optical
Computational Techniques in Visual Information Processing
Introduces fundamental concepts, algorithms, and
Segmentation, Representation and Description, Recognition and Interpretation
Prerequisites: ESE 214 and 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 220
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 220
Prerequisites for CSE majors: CSE 214 and 220
3 credits
ESE 362 Optoelectronic Devices and Optical Imaging Techniques
A thorough introduction to the field of optoelectronics including a firm basis of fundamental physics, optical imaging, and optical communication systems. A detailed coverage of laser and semiconductor devices along with a study of the commonly used optical radi-
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