

# 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)

## Faculty

Gregory L. Belenky, Professor, Ph.D., *Institute of Semiconductors, Kiev, Ukraine; D.Sc., Institute of Physics and Mathematics, Baku, Russia*: Semiconductor devices; physics and technology; lasers for telecommunication.

Monica Fernandez Bugallo, Assistant Professor, Ph.D., *University of A Coruna, Spain*: Statistical signal processing and its applications to multiuser communications, smart antenna systems, target tracking and vehicle positioning and navigation.

Sheldon S.L. Chang, Professor Emeritus, Ph.D., *Purdue University*: Optimal control; energy conservation; information theory; economic theory.

Chi-Tsong Chen, Professor, Ph.D., *University of California, Berkeley*: Systems and control theory; digital signal processing.

Harbans S. Dhadwal, Associate Professor, Ph.D., *University of London*: Fiber-optic sensors; optical signal processing; photon correlation spectroscopy; inverse problems.

Petar M. Djuric, Professor, Ph.D., *University of Rhode Island*: Signal processing; systems theory.

Alex Doboli, Assistant Professor, Ph.D., *University of Cincinnati*: VLSI; CAD with emphasis on hardware/software co-design; mixed-signal synthesis and high-level systems.

Dmitri Donetski, Assistant Professor, Ph.D., *St. Petersburg Technical University, Russia; Ph.D. Stony Brook University*: Design of long-wavelength detectors; photovoltaic cells and high power laser diode arrays.

Mikhail N. Dorojevets, Associate Professor, Ph.D., *Russian Academy of Sciences, Novosibirsk*: Parallel computer architecture; high-performance systems design.

Vera Gorfinkel, Associate Professor, Ph.D., *A.F. Ioffe Physical-Technical Institute, St. Petersburg, Russia*: Semiconductor devices, including microwave and optoelectronics.

Sangjin Hong, Assistant Professor, Ph.D., *University of Michigan*: Low-power VLSI design of multimedia wireless communications and digital signal processing systems, including SOC design methodology and optimization.

Ridha Kamoua, Associate Professor, Ph.D., *University of Michigan*: Solid-state devices and circuits; microwave devices and integrated circuits.

Serge Luryi, Professor, Ph.D., *University of Toronto*: High speed solid-state electronic and photonic devices; semiconductor physics and technology.

Velio A. Marsocci, Distinguished Service Professor Emeritus, Eng.Sc.D., *New York University*: Solid-state electronics; integrated electronics; biomedical engineering.

John Murray, Associate Professor, Ph.D., *University of Notre Dame*: Signal processing; systems theory.

Jayantkumar P. Parekh, Professor, Ph.D., *Polytechnic Institute of Brooklyn*: Microwave acoustics; microwave magnetics; microwave electronics; microcomputer applications.

Thomas G. Robertazzi, Professor, Ph.D., *Princeton University*: Computer communications; performance evaluation; parallel processing.

Yacov Shamash, Professor, Ph.D., *Imperial College*: Control systems and robotics.

Leon Shterengas, Assistant Professor, Ph.D., *Stony Brook University*: High power and high speed light emitters; carrier dynamics in nanostructures; molecular beam epitaxy.

Kenneth L. Short, Professor, Ph.D., *Stony Brook University*: Digital system design; embedded microprocessor systems; instrumentation. Recipient of the State University Chancellor's Award for Excellence in Teaching, 1985, and the President's Award for Excellence in Teaching, 1985.

Milutin Stanacevic, Assistant Professor, Ph.D., *Johns Hopkins University*: Analog and mixed-signal VLSI integrated circuits and systems; adaptive microsystems; implantable electronics.

Muralidhara Subbarao, Professor, Ph.D., *University of Maryland at College Park*: Computer vision; image processing.

Stephen E. Sussman-Fort, Associate Professor, Ph.D., *University of California, Los Angeles*: Electronic circuits; CAD; solid-state electronics; electromagnetics; semiconductor devices.

Wendy K. Tang, Associate Professor, Ph.D., *University of Rochester*: Parallel and distributed processing; massively parallel systems; computer architecture; neural networks.

Hang-Sheng Tuan, Professor, Ph.D., *Harvard University*: Electromagnetic theory; integrated optics; microwave acoustics.

Xin Wang, Assistant Professor, Ph.D., *Columbia University*: Mobile and ubiquitous computing; wireless communications and networks; grid and distributed computing; advanced applications and services over Internet and wireless networks.

Yuanyuan Yang, Professor, Ph.D., *Johns Hopkins University*: Parallel and distributed computing and systems; high speed networks; optical networks; high performance computer architecture; fault-tolerant computing.

## Adjunct Faculty

Estimated number: 3

## Teaching Assistants

Estimated number: 30

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. Both program majors are accredited by the Accreditation Board of Engineering and Technology (ABET).

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.

### Courses Offered in Electrical and Computer Engineering

See the Course Descriptions listing in this *Bulletin* for complete information.

ESE 123 Introduction to Electrical and Computer Engineering

ESE 124 Computer Techniques for Electronic Design I

ESE 211 Electronics Laboratory 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 I

ESE 290 Transitional Study

ESE 300 Technical Communication for Electrical and Computer Engineers

ESE 304 Applications of Operational Amplifiers

ESE 305 Deterministic Signals and Systems

ESE 306 Random Signals and Systems

ESE 307 Analog Filter Design

ESE 310 Electrical Circuit Analysis II

ESE 311 Analog Integrated Circuits

ESE 312 Microwave Electronics

ESE 314 Electronics Laboratory B

ESE 315 Control System Design

ESE 316 Digital Devices and Circuits

ESE 319 Introduction to Electromagnetic Fields and Waves

ESE 320 Microwave Electronics Laboratory

ESE 321 Electromagnetic Waves and Wireless Communication

ESE 322 Introduction to Auto ID Technologies

ESE 323 RFID Technology for Automatic Identification

ESE 324 Electronics Laboratory C

ESE 330 Integrated Electronics

ESE 332 Semiconductor Device Characterization

ESE 333 Real-Time Operating Systems

ESE 337 Digital Signal Processing: Theory

ESE 340 Basic Communication Theory

ESE 341 Introduction to Wireless and Cellular Communication

ESE 342 Digital Communications Systems

ESE 343 Modern Electronic Communications Laboratory

ESE 344 Software Techniques for Engineers

ESE 345 Computer Architecture

ESE 346 Computer Communications

ESE 347 Digital Signal Processing: Implementation

ESE 349 Introduction to Fault Diagnosis of Digital Systems

ESE 350 Electrical Power Systems

ESE 351 Energy Conversion

ESE 352 Electromechanical Energy Converters

ESE 355 VLSI System Design

- ESE 356 Digital System Specification and Modeling
- ESE 357 Digital Image Processing
- ESE 358 Computer Vision
- ESE 360 Network Security Engineering
- ESE 362 Optoelectronic Devices and Optical Imaging Techniques
- ESE 363 Fiber Optic Communications
- ESE 366 Design using Programmable Mixed-Signal-Systems-on-Chip
- ESE 371 Computer Graphics
- ESE 372 Electronics
- ESE 373 RF Electronics for Wireless Communications
- ESE 380, 381 Embedded Microprocessor Systems Design I, II
- ESE 382 Digital Design Using VHDL and PLDs
- ESE 390 Special Topics in Digital Systems
- ESE 440, 441 Engineering Design I, II
- ESE 475 Undergraduate Teaching Practicum
- ESE 476 Instructional Laboratory Development Practicum
- ESE 488 Internship in Electrical/Computer Engineering
- ESE 499 Research in Electrical Sciences

**Acceptance into the Electrical Engineering 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 courses with no grade in any of them lower than C

**Notes to Sample Course Sequences**

Courses with a # must be passed with a grade of C or higher.  
Total credits must equal 128 or higher.

**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 131/133#           |  | 4       | PHY 132/134#           |  | 4       |
| ESE 123                |  | 4       | ESE 124                |  | 3       |
| D.E.C. A#              |  | 3       | CHE 131                |  | 4       |
| Total                  |  | 15-16   | Total                  |  | 15-16   |

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

| GENERAL TRACK        |  |         |                  |  |         |
|----------------------|--|---------|------------------|--|---------|
| Junior Fall          |  | Credits | Junior Spring    |  | Credits |
| AMS 210 (or MAT 211) |  | 3       | ESE xxx#         |  | 3       |
| ESE 314              |  | 3       | ESE xxx#         |  | 3       |
| ESE 319              |  | 3       | ESE 324          |  | 2       |
| ESE 337#             |  | 3       | ESE 300#         |  | 3       |
| D.E.C.               |  | 3       | 2 D.E.C. courses |  | 6       |
| Total                |  | 15      | Total            |  | 17      |

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

| MICROELECTRONICS SPECIALIZATION |  |         |               |  |         |
|---------------------------------|--|---------|---------------|--|---------|
| Junior Fall                     |  | Credits | Junior Spring |  | Credits |
| AMS 210 (or MAT 211)            |  | 3       | ESE 355#      |  | 4       |
| ESE 314                         |  | 3       | ESE 324       |  | 2       |
| ESE 319                         |  | 3       | ESE 300       |  | 3       |
| ESE 337#                        |  | 3       | ESE 311#      |  | 3       |
| ESE 373#                        |  | 3       | D.E.C.        |  | 3       |
| D.E.C.                          |  | 3       | Total         |  | 15      |
| Total                           |  | 18      |               |  |         |

| Senior Fall |  | Credits | Senior Spring      |  | Credits |
|-------------|--|---------|--------------------|--|---------|
| ESE 440     |  | 3       | ESE 441            |  | 3       |
| ESE 330#    |  | 3       | ESE 304#           |  | 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 347#      |  | 4       |
| ESE 314                           |  | 3       | ESE 324       |  | 2       |
| ESE 319                           |  | 3       | ESE 300#      |  | 3       |
| ESE 337#                          |  | 3       | ESE 342#      |  | 3       |
| ESE 340#                          |  | 3       | D.E.C.        |  | 3       |
| D.E.C.                            |  | 3       | Total         |  | 15      |
| Total                             |  | 18      |               |  |         |

| Senior Fall        |  | Credits | Senior Spring |  | Credits |
|--------------------|--|---------|---------------|--|---------|
| ESE 440            |  | 3       | ESE 441       |  | 3       |
| ESE 380            |  | 4       | ESE 363#      |  | 4       |
| Technical elective |  | 3       | ESE 346#      |  | 3       |
| 2 D.E.C. courses   |  | 6       | D.E.C.        |  | 3       |
| Total              |  | 16      | D.E.C.        |  | 3       |
|                    |  |         | Total         |  | 16      |

3. no courses required for the major have been repeated
4. all transfer courses have been evaluated.

### Requirements for the Major in Electrical Engineering (ESE)

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, 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, 161 in major requirements or prerequisites:

MAT 125, 126, 127

or MAT 131, 132

or MAT 141, 142

or MAT 171

#### 2. Natural Sciences

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

CHE 131 General Chemistry I and Laboratory

Note: The physics course sequence PHY 125, 126, 127 or 141, 142 is accepted in lieu of PHY 131/133, 132/134. (Students are advised to take PHY 127 before PHY 126.) The chemistry course sequence CHE 141 and 143 or ESG 198 are accepted in lieu of CHE 131 and 133.

#### 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 technical electives and 2 non-ESE technical electives

##### b. Microelectronics

ESE 304 Applications of Operational Amplifiers

ESE 311 Analog Integrated Circuits

ESE 330 Integrated Electronics

ESE 355 VLSI System Design

ESE 373 RF Electronics for Wireless Communications

1 non-ESE technical elective

##### c. Telecommunications

ESE 340 Basic Communication Theory

ESE 342 Digital Communications Systems

ESE 346 Computer Communications

ESE 347 Digital Signal Processing: Implementation

ESE 363 Fiber Optic Communications

1 non-ESE technical elective

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 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 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, 324, 380, or 382. Students whose writing does not meet the required standard are referred for remedial help. Detailed guidelines are provided by the Department.

#### 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 Combined B.E./M.S. degrees in Electrical Engineering**

The intent of the combined five-year Bachelor of Engineering and Master of Science in Electrical 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 combined 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 3.40) as well as undergraduate research and professional activities. The combined program is as rigorous as the current B.E. and M.S. programs taken separately. The requirements for the combined 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 in Electrical Engineering (ESE)**

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, 275, 300, 324, 440, 441, 475, 476, 488, or 499 for credit toward the minor.