

**Fluid Mechanics**

Complete the following course:

CIV U331 Fluid Mechanics 4 SH

**Environmental Engineering and Soil Mechanics**

Complete the following two courses and corresponding lab:

CIV U334 Environmental Engineering 1 4 SH

CIV U340 Soil Mechanics 4 SH

with CIV U341 Lab for CIV U340 1 SH

**Probability and Engineering Economy**

Complete the following course:

CIV U464 Probability and Engineering Economy 4 SH  
for Civil Engineering

**Civil Engineering Technical Electives**

Complete three courses from the following list with corresponding lab if applicable:

CIV U425 Steel Design 4 SH

CIV U522 Structural Analysis 2 4 SH

CIV U534 Environmental Engineering 2 3 SH

with CIV U535 Lab for CIV U534 1 SH

CIV U542 Foundation Engineering 4 SH

CIV U553 Transport Analysis and Planning 4 SH

CIV U556 Traffic Engineering 4 SH

CIV U575 Construction Management 3 SH

**Civil Engineering Project Elective**

Complete one course from the following list:

CIV U536 Hydrologic Engineering 4 SH

CIV U554 Highway Engineering 4 SH

**Capstone**

Complete the following course:

CIV U769 Senior Design Project 5 SH

**CIVIL ENGINEERING GENERAL ELECTIVE REQUIREMENTS**

Complete four 4-SH-equivalent, nonremedial, nonrepetitive courses from the following departments:

ACC, AFR, ARC, ART, ASL, BIO, CHE, CHM, CIN, CIV, CJ, CMN, CS, ECE, ECN, ED, ENG, ENT, ENV, FIN, GEO, HRM, HS, HST, IAF, INB, INT, IS, JRN, LIN, LNA, LNC, LNF, LNG, LNH, LNI, LNJ, LNL, LNM, LNR, LNS, MGT, MIM, MIS, MKT, MMS, MSC, MTH, MUS, PHL, PHY, POL, PSY, SCM, SOA, SOC, or THE.

**GPA REQUIREMENT**

2.000 GPA required in the major

**GENERAL ELECTIVES**

Additional courses taken beyond college and major course requirements to satisfy graduation credit requirements.

**COOPERATIVE EDUCATION****UNIVERSITY-WIDE REQUIREMENTS**

136 total semester hours required

Minimum 2.000 GPA required

**ELECTRICAL AND COMPUTER ENGINEERING**

[www.ece.neu.edu](http://www.ece.neu.edu)

STEPHEN W. MCKNIGHT, PHD

*Professor and Interim Chair*

**WILLIAM LINCOLN SMITH PROFESSOR OF ELECTRICAL AND COMPUTER ENGINEERING**

Vincent Harris, PhD

**ROBERT BLACK PROFESSOR OF ENGINEERING**

Michael B. Silevitch, PhD

**ITC PROFESSOR**

Fabrizio Lombardi, PhD

**COLLEGE OF ENGINEERING DISTINGUISHED PROFESSORS**

Anthony J. Devaney, PhD

Carmine Vittoria, PhD

**PROFESSORS**

Nicol E. McGruer, PhD

Sarma S. Mulukutla, PhD

Carey M. Rappaport, ScD

Philip E. Serafim, ScD

Bahram Shafai, ScD

Aleksandar M. Stankovic, PhD

Gilead Tadmor, PhD

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Dana H. Brooks, PhD

Charles DiMarzio, PhD

Jeffrey A. Hopwood, PhD

Vinay K. Ingle, PhD

David R. Kaeli, PhD

Mieczyslaw M. Kokar, PhD

Miriam E. Leeser, PhD

Bradley M. Lehman, PhD

Hanoch Lev-Ari, PhD

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Waleed Meleis, PhD

Eric Miller, PhD

Masoud Salehi, PhD

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Edwin Marengo, PhD

A. Bruce McDonald, PhD

Demetrios P. Papageorgiou, PhD

Purmina Ratilal, PhD

Nian-Xiang Sun, PhD

Medhi Tahoori, PhD

**LECTURER**

Jacob Shekel, ScD

**PROFESSORS EMERITI**

Arvin Grabel, ScD

Sheila Prasad-Hinchey, PhD

John G. Proakis, PhD

Harold Raemer, PhD

Martin E. Schetzen, ScD

The Department of Electrical and Computer Engineering offers two distinct Bachelor of Science programs: Bachelor of Science in electrical engineering (BSEE) and Bachelor of Science in computer engineering (BSCompE). An integrated dual major is available in electrical and computer engineering for students who complete the requirements of both majors. In addition, a minor in electrical engineering, a minor in computer engineering, and a minor in biomedical engineering are available to qualified students throughout the University, including majors within the department.

Successful engineers need to organize and adapt information to solve problems. They also must work effectively in teams and communicate well. The electrical engineering and computer engineering programs develop these skills and provide the appropriate technical background for a successful career. The objectives of the Bachelor of Science programs are that every student will develop and apply in an engineering context: (1) mathematical, scientific, computational, and experiential knowledge and skills; (2) the technical skills necessary for engineering practice; (3) the communications and interpersonal skills necessary as engineering professionals; (4) a personal and professional ethic appropriate to the practice of engineering; and (5) an awareness of the social, cultural, and historical context of engineering solutions.

The curricula are continuously assessed to ensure that graduates can achieve these goals and go on to succeed as professional electrical or computer engineers. The Bachelor of Science programs allow students sufficient flexibility within the standard eight academic semesters to earn a minor in nearly any department in the University. Typical minors might include electrical engineering, computer engineering, physics, math, computer science, or business, but students might also organize their course of study to earn a minor in economics, English, or music.

The academic program is supported by extensive laboratory facilities for study and experimentation in computing, circuits analysis, electronics, digital systems, microwaves, control systems, semiconductor processing, VLSI design, and digital signal processing. Students have access to state-of-the-art computing facilities, including numerous UNIX-based Sun and Compaq workstations, and Windows-based personal computers, all connected to the Internet. Many courses are taught in one of the four computer-based teaching classrooms, where students work online and practice the theory presented in lecture while still in the classroom.

More than 90 percent of department undergraduates take advantage of the cooperative education program. During the

cooperative work phase of the program, the students' levels of responsibility grow as they gain theoretical and technical knowledge through academic work. A sophomore might begin cooperative work experience as an engineering assistant and progress by the senior year to a position with responsibilities similar to those of entry-level engineers.

A senior-year design course caps the education by drawing on everything learned previously. Teams of students propose, design, and build a functioning electrical or computer engineering system—just as they might in actual practice.

**Electrical Engineering**

The components of the Information Age—global communication systems, computers and computer chips, and the software that runs them, as well as pacemakers, magnetic resonance imaging, and interplanetary space missions—are possible because of the efforts of electrical engineers. Today, electrical engineers are developing concepts and working to translate these ideas into the next generation of products, from computers and safe, energy-efficient vehicles, to radar that can detect unexploded land mines from the air, to microrobots that diagnose disease from inside the body.

Many electrical engineers work in the traditional areas of communications, computation, and control, and components required to realize such systems. They are involved in design and product development, testing and quality control, sales and marketing, and manufacturing. Others use their problem-solving skills in diverse areas such as bioengineering, health care, electronic music, meteorology, and experimental psychology. Some graduates draw on their electrical engineering backgrounds to launch successful careers as physicians, financial analysts, attorneys, and entrepreneurs.

As specified below, the BSEE degree requires a sequence of core courses and advanced study in one or more technical elective areas: electronic circuits and devices; signals and systems; fields, waves, and optics; power engineering; or computer engineering. Electives in historical perspective, social/cultural perspective, and social science/humanities are also required. See pages 307–313 for course descriptions.

**BSEE—Bachelor of Science in Electrical Engineering****ENGLISH REQUIREMENT**

Complete the following course:

ENG U111 College Writing 4 SH  
and one approved Advanced Writing in the Disciplines course for the major. A grade of C or higher is required in both courses.

**ENGINEERING CATEGORICAL REQUIREMENT**

Students must complete a minimum of semester hours in the categories of math/science and engineering topics. Completing all courses in the prescribed curriculum satisfies these requirements without any additional consideration. However, any student with transfer credit or course substitutions must meet with an academic adviser to plan appropriate course work to assure that these requirements are fully satisfied.

**ELECTRICAL ENGINEERING GENERAL EDUCATION****Mathematics and Science****CALCULUS 1 AND 2 FOR SCIENCE/ENGINEERING**

Complete the following two courses:

MTH U241	Calculus 1 for Science and Engineering	4 SH
MTH U242	Calculus 2 for Science and Engineering	4 SH

**PHYSICS 1 AND 2**

Complete the following two courses with corresponding labs:

PHY U151	Physics for Engineering 1	4 SH
with PHY U152	Lab for PHY U151	1 SH
or PHY U161	Physics 1	4 SH
with PHY U162	Lab for PHY U161	1 SH
PHY U155	Physics for Engineering 2	4 SH
with PHY U156	Lab for PHY U155	1 SH
or PHY U165	Physics 2	4 SH
with PHY U166	Lab for PHY U165	1 SH

**CHEMISTRY**

Complete the following course:

CHM U151	General Chemistry for Engineers	4 SH
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**DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA**

Complete the following course:

MTH U343	Differential Equations and Linear Algebra for Engineering	4 SH
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**CALCULUS 3 FOR SCIENCE AND ENGINEERING**

Complete the following course:

MTH U341	Calculus 3 for Science and Engineering	4 SH
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**ALGORITHMS AND DATA STRUCTURES**

Complete the following course with corresponding lab:

CS U215	Algorithms and Data Structures for Engineering	4 SH
with CS U216	Lab for CS U215	1 SH

**Arts and Humanities**

Complete two courses from the “College of Engineering Arts and Humanities Requirements” on page 213. Also, complete one additional course from the following departments: ARC, ART, CJ, ECN, ENG, MUS, PHL, POL, PSY, SOC, or THE.

**ELECTRICAL ENGINEERING MAJOR REQUIREMENTS****First-Year Engineering**

Complete the following two courses:

GE U110	Engineering Design	4 SH
GE U111	Engineering Problem Solving and Computation	4 SH

**General Engineering**

Complete the following three courses:

ECE U300	Introduction to Engineering Co-op Education	1 SH
ECE U500	Professional Issues in Engineering	1 SH
GE U100	Introduction to the Study of Engineering	1 SH

**Electrical Engineering Lab**

Complete the following course:

ECE U401	Introduction to Electrical and Computer Engineering Lab	1 SH
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**Linear Circuits**

Complete the following course:

ECE U400	Linear Circuits	4 SH
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**Electronics**

Complete the following course with corresponding lab:

ECE U402	Electronics	4 SH
with ECE U403	Lab for ECE U402	1 SH

**Digital Logic Design**

Complete the following course with corresponding lab:

ECE U322	Digital Logic Design	4 SH
with ECE U323	Lab for ECE U322	1 SH

**Linear Systems**

Complete the following course:

ECE U464	Linear Systems	4 SH
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**Electromagnetic Fields and Waves**

Complete the following course with corresponding lab:

ECE U440	Electromagnetic Fields and Waves	4 SH
with ECE U441	Lab for ECE U440	1 SH

**Noise and Stochastic Processes**

Complete the following course:

ECE U468	Noise and Stochastic Processes	4 SH
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**Communication Systems**

Complete the following course:

ECE U572	Communications Systems 1	4 SH
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**Electrical Engineering Technical Electives**

Complete four 4-SH-equivalent courses from the following list:

ECE U301 to ECE U699

**Capstone Design**

Complete the following two courses:

ECE U790	Electrical and Computer Engineering Capstone 1	4 SH
ECE U792	Electrical and Computer Engineering Capstone 2	4 SH

**ELECTRICAL ENGINEERING GENERAL ELECTIVE REQUIREMENTS**

Complete four 4-SH-equivalent, nonremedial, nonrepetitive courses from the following departments:

ACC, AFR, ARC, ART, ASL, BIO, CHE, CHM, CIN, CIV, CJ, CMN, CS, ECE, ECN, ED, ENG, ENT, ENV, FIN, GEO, HRM, HS, HST, IAF, INB, INT, IS, JRN, LIN, LNA, LNC, LNF, LNG, LNH, LNI, LNJ, LNL, LNM, LNR, LNS, MGT, MIM, MKT, MMS, MSC, MTH, MUS, PHL, PHY, POL, PSY, SCM, SOA, SOC, or THE.

**GPA REQUIREMENT**

2.000 GPA required in the major

**GENERAL ELECTIVES**

Additional courses taken beyond college and major course requirements to satisfy graduation credit requirements.

**COOPERATIVE EDUCATION****UNIVERSITY-WIDE REQUIREMENTS**

138 total semester hours required

Minimum 2.000 GPA required

## Minor in Electrical Engineering

A minor in electrical engineering is open to all students in the University with the prerequisite calculus and physics background. The minor is designed for students who would like a coherent background in the theory and laboratory practice of electrical engineering, particularly for majors in math, science, computer engineering, or other engineering departments. The completion of a minor in electrical engineering will be recognized by a notation on the student's transcript.

## Minor in Electrical Engineering

### CORE COURSES

Complete one of the following courses with corresponding lab:

ECE U210	Electrical Engineering	4 SH
with ECE U211	Lab for ECE U210	1 SH
ECE U400	Linear Circuits	4 SH
with ECE U401	Introduction to Electrical and Computer Engineering Lab	1 SH

### ELECTIVE CORE COURSES

Complete two of the following courses with corresponding labs:

ECE U322	Digital Logic Design	4 SH
with ECE U323	Lab for ECE U322	1 SH
ECE U402	Electronics	4 SH
with ECE U403	Lab for ECE U402	1 SH
ECE U440	Electromagnetic Fields and Waves	4 SH
with ECE U441	Lab for ECE U440	1 SH

### ELECTRICAL ENGINEERING TECHNICAL ELECTIVES

Complete 5 semester hours of electrical engineering technical electives from the following list:

ECE U440	Electromagnetic Fields and Waves	4 SH
with ECE U441	Lab for ECE U440	1 SH
ECE U464	Linear Systems	4 SH
ECE U468	Noise and Stochastic Processes	4 SH
ECE U524	VLSI Design	4 SH
with ECE U525	Lab for ECE U524	1 SH
ECE U572	Communications Systems 1	4 SH
ECE U574	Wireless Communication Circuits	4 SH
ECE U576	Wireless Personal Communications Systems	4 SH
ECE U580	Classical Control Systems	4 SH
with ECE U581	Lab for ECE U580	1 SH
ECE U600	Electronic Design	4 SH
with ECE U601	Lab for ECE U600	1 SH
ECE U604	Semiconductor Device Theory	4 SH
ECE U606	Integrated Circuit Fabrication	4 SH
ECE U642	Antennas	4 SH
ECE U644	Microwave Networks	4 SH
ECE U646	Optics	4 SH
ECE U666	Digital Signal Processing	4 SH
with ECE U667	Lab for ECE U666	1 SH
ECE U672	Communication Systems 2	4 SH
ECE U680	Electric Drives	4 SH
ECE U682	Power Systems Analysis	4 SH

with ECE U683	Power Systems Lab	1 SH
ECE U684	Power Electronics	4 SH
ECE U686	Electrical Machines	4 SH
ECE U692	Subsurface Sensing and Imaging	4 SH

### GPA REQUIREMENT

2.000 GPA required in the minor

## Computer Engineering

The use of computer technology is exploding, driven by applications in wireless communications, multimedia, portable devices, and Internet computing. At the core of these technological advances are computer engineers who research, design, and develop hardware and software. With a degree in computer engineering you might develop an e-business Web site, design the next-generation microprocessor, write an embedded real-time operating system, or start your own software company.

The computer engineering major acquires a strong foundation in engineering principles and the physical sciences in addition to a powerful mix of theory and practice in hardware and software design. The core of the computer engineering curriculum comprises courses in computer organization and architecture, operating systems, computer-aided design, programming languages, optimization theory, and software design.

As specified below, the BSCompE degree requires a sequence of core courses, technical electives, general (free) electives, and electives in historical perspective, social/cultural perspective, and social science/humanities. See pages 307–313 for course descriptions.

## BSCompE—Bachelor of Science in Computer Engineering

### ENGLISH REQUIREMENT

Complete the following course:

ENG U111	College Writing	4 SH
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and one approved Advanced Writing in the Disciplines course for the major. A grade of C or higher is required in both courses.

### ENGINEERING CATEGORICAL REQUIREMENT

Students must complete a minimum of semester hours in the categories of math/science and engineering topics. Completing all courses in the prescribed curriculum satisfies these requirements without any additional consideration. However, any student with transfer credit or course substitutions must meet with an academic adviser to plan appropriate course work to assure that these requirements are fully satisfied.

### COMPUTER ENGINEERING GENERAL EDUCATION

#### Mathematics and Science

#### CALCULUS 1 AND 2 FOR SCIENCE AND ENGINEERING

Complete the following two courses:

MTH U241	Calculus 1 for Science and Engineering	4 SH
MTH U242	Calculus 2 for Science and Engineering	4 SH

**PHYSICS 1 AND 2**

Complete two courses with corresponding labs from the following list:

PHY U151	Physics for Engineering 1	4 SH
with PHY U152	Lab for PHY U151	1 SH
or PHY U161	Physics 1	4 SH
with PHY U162	Lab for PHY U161	1 SH
PHY U155	Physics for Engineering 2	4 SH
with PHY U156	Lab for PHY U155	1 SH
or PHY U165	Physics 2	4 SH
with PHY U166	Lab for PHY U165	1 SH

**CHEMISTRY**

Complete the following course:

CHM U151	General Chemistry for Engineers	4 SH
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**DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA**

Complete the following course:

MTH U343	Differential Equations and Linear Algebra for Engineering	4 SH
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**DISCRETE MATHEMATICS**

Complete the following course:

MTH U230	Discrete Mathematics	4 SH
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**PROBABILITY AND STATISTICS**

Complete the following course:

MTH U481	Probability and Statistics	4 SH
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**ALGORITHMS AND DATA STRUCTURES**

Complete the following course with corresponding lab:

CS U215	Algorithms and Data Structures for Engineering	4 SH
with CS U216	Lab for CS U215	1 SH

**Arts and Humanities**

Complete two courses from the “College of Engineering Arts and Humanities Requirements” on page 213. Also, complete one additional course from the following departments: ARC, ART, CJ, ECN, ENG, MUS, PHL, POL, PSY, SOC, or THE.

**COMPUTER ENGINEERING MAJOR REQUIREMENTS****First-Year Engineering**

Complete the following two courses:

GE U110	Engineering Design	4 SH
GE U111	Engineering Problem Solving and Computation	4 SH

**General Engineering**

Complete the following three courses:

ECE U300	Introduction to Engineering Co-op Education	1 SH
ECE U500	Professional Issues in Engineering	1 SH
GE U100	Introduction to the Study of Engineering	1 SH

**Electrical Engineering Lab**

Complete the following course:

ECE U401	Introduction to Electrical and Computer Engineering Lab	1 SH
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**Linear Circuits**

Complete the following course:

ECE U400	Linear Circuits	4 SH
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**Electronics**

Complete the following course with corresponding lab:

ECE U402	Electronics	4 SH
with ECE U403	Lab for ECE U402	1 SH

**Digital Logic Design**

Complete the following course with corresponding lab:

ECE U322	Digital Logic Design	4 SH
with ECE U323	Lab for ECE U322	1 SH

**Computer Architecture/Organization**

Complete the following course:

ECE U324	Computer Architecture and Organization	4 SH
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**Optimization Methods**

Complete the following course:

ECE U326	Optimization Methods	4 SH
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**Computer Networks**

Complete the following course with corresponding lab:

ECE U628	Computer and Telecommunication Networks	4 SH
with ECE U629	Internetworking Design Lab	1 SH

**Computer Engineering Technical Electives**

Complete four 4-SH-equivalent courses from the following list.

Only one course may be from computer science.

CS U370	Object-Oriented Design	4 SH
CS U390	Theory of Computation	4 SH
CS U430	Database Design	4 SH
CS U480	Systems and Networks	4 SH
CS U520	Artificial Intelligence	4 SH
CS U540	Computer Graphics	4 SH
CS U660	Programming Languages	4 SH
CS U665	Compilers	4 SH
CS U680	Topics in Operating Systems	4 SH
ECE U301 to ECE U699		

**Capstone Design**

Complete the following two courses:

ECE U790	Electrical and Computer Engineering Capstone 1	4 SH
ECE U792	Electrical and Computer Engineering Capstone 2	4 SH

**COMPUTER ENGINEERING GENERAL ELECTIVE REQUIREMENTS**

Complete four 4-SH-equivalent, nonremedial, nonrepetitive courses from the following departments:

ACC, AFR, ARC, ART, ASL, BIO, CHE, CHM, CIN, CIV, CJ, CMN, CS, ECE, ECN, ED, ENG, ENT, ENV, FIN, GEO, HRM, HS, HST, IAF, INB, INT, IS, JRN, LIN, LNA, LNC, LNF, LNG, LNH, LNI, LNJ, LNL, LNM, LNR, LNS, MGT, MIM, MKT, MMS, MSC, MTH, MUS, PHL, PHY, POL, PSY, SCM, SOA, SOC, or THE.

**GPA REQUIREMENT**

2.000 GPA required in the major

**GENERAL ELECTIVES**

Additional courses taken beyond college and major course requirements to satisfy graduation credit requirements.

**COOPERATIVE EDUCATION****UNIVERSITY-WIDE REQUIREMENTS**

138 total semester hours required

Minimum 2.000 GPA required

**Minor in Computer Engineering**

The minor in computer engineering is open to all students in the University. The minor is designed for students who would like a coherent background in the theory and laboratory practice of computer engineering. The completion of a minor in computer engineering will be recognized by a notation on the student's transcript.

**Minor in Computer Engineering****CORE COURSE**

Complete the following course with corresponding lab:

CS U215 Algorithms and Data Structures 4 SH  
for Engineering

with CS U216 Lab for CS U215 1 SH

Computer science majors may substitute the following course with corresponding lab:

CS U211 Fundamentals of Computer Science 1 4 SH

with CS U212 Lab for CS U211 1 SH

**MAJOR CORE COURSES**

Complete the following two courses with corresponding labs:

ECE U322 Digital Logic Design 4 SH

with ECE U323 Lab for ECE U322 1 SH

ECE U324 Computer Architecture 4 SH  
and Organization

Computer science majors may substitute the following two courses for ECE U324:

CS U380 Computer Organization 4 SH

ECE U230 Computer Architecture for 4 SH  
Computer Scientists

**COMPUTER ENGINEERING TECHNICAL ELECTIVES**

Complete 4 semester hours of course work from the following list:

ECE U326 Optimization Methods 4 SH

ECE U520 Software Engineering 1 4 SH

ECE U522 Software Engineering 2 4 SH

ECE U524 VLSI Design 4 SH

with ECE U525 Lab for ECE U524 1 SH

ECE U526 High-Speed Digital Design 4 SH

ECE U528 CAD for Design and Test 4 SH

ECE U530 Hardware Description Languages 4 SH  
and Synthesis

ECE U534 Microprocessor-Based Design 4 SH

with ECE U535 Lab for ECE U534 1 SH

ECE U622 Parallel and Distributed Processing 4 SH

ECE U626 Image Processing and Pattern 4 SH  
Recognition

ECE U628 Computer and Telecommunication 4 SH  
Networks

with ECE U629 Internetworking Design Lab 1 SH

ECE U630 Robotics 4 SH

ECE U694 Numerical Methods and Computer 4 SH  
Applications

**GPA REQUIREMENT**

2.000 GPA required in the minor

**Minor in Biomedical Engineering**

Medical imaging and biomedical electronics are important areas of biomedical engineering that are within the province of electrical engineering. The minor in biomedical engineering is open to all students in the University with the prerequisite calculus and physics background. The minor is particularly designed for majors in electrical or computer engineering, biology, health science fields, or other engineering departments who would like a background in relevant aspects of biology and electrical engineering, with the opportunity to complete an interdisciplinary biomedical engineering (capstone) design project. Course work in anatomy and physiology and other health science topics is combined with technical engineering courses related to biomedical imaging and instrumentation. Specific curriculum information about the biomedical engineering minor may be obtained from the Department of Electrical and Computer Engineering office, 411 Dana, from the department Web site, or by calling 617.373.2165.

**Minor in Biomedical Engineering****REQUIRED CORE COURSES**

Complete the following three courses and corresponding labs:

BIO U117 Integrated Anatomy and Physiology 1 4 SH

with BIO U118 Lab for BIO U117 1 SH

ECE U401 Introduction to Electrical 1 SH  
and Computer Engineering Lab

ECE U512 Biomedical Electronics 4 SH

or ECE U664 Biomedical Signal Processing 4 SH  
and Medical Imaging

**REQUIRED CAPSTONE-DESIGN COURSE**

Complete the following two courses on a biologically oriented project:

ECE U790 Electrical and Computer Engineering 4 SH  
Capstone 1

ECE U792 Electrical and Computer Engineering 4 SH  
Capstone 2

**ELECTIVE COURSES**

Complete 8 semester hours of course work from the following list:

**Electrical Engineering**

ECE U210 Electrical Engineering 4 SH

**Biology**

BIO U119 Integrated Anatomy and Physiology 2 4 SH

with BIO U120 Lab for BIO U119 1 SH

BIO U319 Regulatory Cell Biology 4 SH

with BIO U320 Lab for BIO U319 1 SH

BIO U321 Microbiology 4 SH

with BIO U322 Lab for BIO U321 1 SH

BIO U551	Principles of Animal Physiology	4 SH
with BIO U552	Lab for BIO U551	1 SH
BIO U573	Medical Microbiology	4 SH
with BIO U574	Lab for BIO U573	1 SH
BIO U587	Comparative Neurobiology	4 SH

**Physics**

PHY U621	Biological Physics 1	4 SH
PHY U623	Medical Physics	4 SH
PHY U651	Medical Physics Seminar 1	4 SH

**Psychology**

PSY U452	Introduction to Sensation and Perception	4 SH
PSY U458	Psychobiology	4 SH

**Cardiopulmonary and Exercise Sciences**

CES U300	Cardiopulmonary Physiology and Pathophysiology	4 SH
CES U301	Cardiopulmonary Assessment	4 SH
CES U302	Cardiopulmonary Disease	4 SH
CES U500	Exercise Physiology 1	4 SH
with CES U501	Lab for CES U500	1 SH
CES U504	Clinical Kinesiology	4 SH
with CES U505	Lab for CES U504	1 SH
CES U508	Echocardiography	4 SH
with CES U509	Lab for CES U508	1 SH

**Physical Therapy**

PTH U308	Neuroscience	4 SH
with PTH U309	Lab for PTH U308	1 SH
PTH U400	Motor Control	3 SH

**Speech-Language Pathology and Audiology**

SLA U103	Anatomy and Physiology of the Vocal Mechanism	4 SH
SLA U202	Neurological Bases of Communication	4 SH
SLA U203	Introduction to Audiology	4 SH
SLA U205	Speech and Hearing Science	4 SH

**GPA REQUIREMENT**

2.000 GPA required in the minor

**Integrated Dual Major in Electrical and Computer Engineering**

Students may choose to major in both electrical and computer engineering by following the integrated dual-major program. Students take the required courses for both majors along with technical electives distributed among the areas of computer engineering; fields, waves, and optics; signals and systems; power engineering; and electronic circuits and devices.

**BSEE or BSCompE—Bachelor of Science in Electrical/Computer Engineering****ENGLISH REQUIREMENT**

Complete the following course:

ENG U111	College Writing	4 SH
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and one approved Advanced Writing in the Disciplines course for the major. A grade of C or higher is required in both courses.

**ENGINEERING CATEGORICAL REQUIREMENT**

Students must complete a minimum of semester hours in the categories of math/science and engineering topics. Completing all courses in the prescribed curriculum satisfies these requirements without any additional consideration. However, any student with transfer credit or course substitutions must meet with an academic adviser to plan appropriate course work to assure that these requirements are fully satisfied.

**DUAL ELECTRICAL/COMPUTER ENGINEERING GENERAL EDUCATION****Mathematics and Science****CALCULUS 1 AND 2 FOR SCIENCE AND ENGINEERING**

Complete the following two courses:

MTH U241	Calculus 1 for Science and Engineering	4 SH
MTH U242	Calculus 2 for Science and Engineering	4 SH

**PHYSICS 1 AND 2**

Complete two courses with corresponding labs from the following list:

PHY U151	Physics for Engineering 1	4 SH
with PHY U152	Lab for PHY U151	1 SH
or PHY U161	Physics 1	4 SH
with PHY U162	Lab for PHY U161	1 SH
PHY U155	Physics for Engineering 2	4 SH
with PHY U156	Lab for PHY U155	1 SH
or PHY U165	Physics 2	4 SH
with PHY U166	Lab for PHY U165	1 SH

**CHEMISTRY**

Complete the following course:

CHM U151	General Chemistry for Engineers	4 SH
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**DISCRETE MATHEMATICS**

Complete the following course:

MTH U230	Discrete Mathematics	4 SH
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**DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA**

Complete the following course:

MTH U343	Differential Equations and Linear Algebra for Engineering	4 SH
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**CALCULUS 3 FOR SCIENCE AND ENGINEERING**

Complete the following course:

MTH U341	Calculus 3 for Science and Engineering	4 SH
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**ALGORITHMS AND DATA STRUCTURES**

Complete the following course with corresponding lab:

CS U215	Algorithms and Data Structures for Engineering	4 SH
with CS U216	Lab for CS U215	1 SH

**Arts and Humanities**

Complete two courses from the "College of Engineering Arts and Humanities Requirements" on page 213. Also, complete one additional course from the following departments:

ARC, ART, CJ, ECN, ENG, MUS, PHL, POL, PSY, SOC, or THE.

**ELECTRICAL/COMPUTER ENGINEERING MAJOR REQUIREMENTS****First-Year Engineering**

Complete the following two courses:

GE U110	Engineering Design	4 SH
GE U111	Engineering Problem Solving and Computation	4 SH

**General Engineering**

Complete the following three courses:

ECE U300	Introduction to Engineering Co-op Education	1 SH
ECE U500	Professional Issues in Engineering	1 SH
GE U100	Introduction to the Study of Engineering	1 SH

**Electrical Engineering Lab**

Complete the following course:

ECE U401	Introduction to Electrical and Computer Engineering Lab	1 SH
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**Linear Circuits**

Complete the following course:

ECE U400	Linear Circuits	4 SH
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**Electronics**

Complete the following course with corresponding lab:

ECE U402	Electronics	4 SH
	with ECE U403 Lab for ECE U402	1 SH

**Digital Logic Design**

Complete the following course with corresponding lab:

ECE U322	Digital Logic Design	4 SH
	with ECE U323 Lab for ECE U322	1 SH

**Linear Systems**

Complete the following course:

ECE U464	Linear Systems	4 SH
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**Electromagnetic Fields and Waves**

Complete the following course with corresponding lab:

ECE U440	Electromagnetic Fields and Waves	4 SH
	with ECE U441 Lab for ECE U440	1 SH

**Computer Architecture/Organization**

Complete the following course:

ECE U324	Computer Architecture and Organization	4 SH
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**Optimization Methods**

Complete the following course:

ECE U326	Optimization Methods	4 SH
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**Computer Networks**

Complete the following course and corresponding lab:

ECE U628	Computer and Telecommunication Networks	4 SH
	with ECE U629 Internetworking Design Lab	1 SH

**Noise and Stochastic Processes**

Complete the following course:

ECE U468	Noise and Stochastic Processes	4 SH
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**Communication Systems**

Complete the following course:

ECE U572	Communications Systems 1	4 SH
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**Dual Electrical/Computer Engineering Technical Electives**

Complete four 4-SH-equivalent courses from the following list.

Only one course may be from computer science:

CS U370	Object-Oriented Design	4 SH
CS U390	Theory of Computation	4 SH
CS U430	Database Design	4 SH
CS U480	Systems and Networks	4 SH
CS U520	Artificial Intelligence	4 SH
CS U540	Computer Graphics	4 SH
CS U660	Programming Languages	4 SH
CS U665	Compilers	4 SH
CS U680	Topics in Operating Systems	4 SH
ECE U301 to ECE U699		

**Capstone Design**

Complete the following two courses:

ECE U790	Electrical and Computer Engineering Capstone 1	4 SH
ECE U792	Electrical and Computer Engineering Capstone 2	4 SH

**GPA REQUIREMENT**

2.000 GPA required in the major

**GENERAL ELECTIVES**

Additional courses taken beyond college and major course requirements to satisfy graduation credit requirements.

**COOPERATIVE EDUCATION****UNIVERSITY-WIDE REQUIREMENTS**

139 total semester hours required

Minimum 2.000 GPA required

**Integrated Dual Major in Electrical Engineering and Physics**

This intercollege dual major serves students who would like to explore their interest in physics while earning the benefit of an accredited Bachelor of Science degree in engineering. The dual major combines a major in physics from the Department of Physics in the College of Arts and Sciences with the Bachelor of Science in Electrical Engineering degree from the Department of Electrical and Computer Engineering.

Because of the large body of shared knowledge between electrical engineering and physics, an integrated dual major between these two disciplines is a logical course of study and can be accomplished within a student's usual five-year program (including three co-op placements) without requiring course overloading in any semester. A student graduating from this program will have studied both the physical fundamentals and the applications of electronic devices and systems. The program is a particularly appropriate course of study for students who wish to pursue a career in solid-state devices, microelectromechanical systems, or nanotechnology.

Students interested in this program should contact the Electrical and Computer Engineering Department or the Physics Department as early as possible, preferably prior to registering for freshman courses.

**BS in Electrical Engineering and Physics****ENGLISH REQUIREMENT**

Complete the following course:

ENG U111 College Writing 4 SH  
and one approved Advanced Writing in the Disciplines course for the major. A grade of C or higher is required in both courses.

**ENGINEERING CATEGORICAL REQUIREMENT**

Students must complete a minimum of semester hours in the categories of math/science and engineering topics. Completing all courses in the prescribed curriculum satisfies these requirements without any additional consideration. However, any student with transfer credit or course substitutions must meet with an academic adviser to plan appropriate course work to assure that these requirements are fully satisfied.

**ELECTRICAL ENGINEERING AND PHYSICS GENERAL EDUCATION****Mathematics and Science****CALCULUS 1 AND 2 FOR SCIENCE AND ENGINEERING**

Complete the following two courses:

MTH U241 Calculus 1 for Science and Engineering 4 SH  
MTH U242 Calculus 2 for Science and Engineering 4 SH

**PHYSICS 1 AND 2**

Complete two courses with corresponding labs:

PHY U161 Physics 1 4 SH  
with PHY U162 Lab for PHY U161 1 SH  
or PHY U151 Physics for Engineering 1 4 SH  
with PHY U152 Lab for PHY U151 1 SH  
PHY U165 Physics 2 4 SH  
with PHY U166 Lab for PHY U165 1 SH  
or PHY U155 Physics for Engineering 2 4 SH  
with PHY U156 Lab for PHY U155 1 SH

**CHEMISTRY**

Complete the following course:

CHM U151 General Chemistry for Engineers 4 SH

**DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA**

Complete the following course(s):

MTH U343 Differential Equations and Linear Algebra for Engineering 4 SH  
or MTH U345 Ordinary Differential Equations 4 SH  
and MTH U371 Linear Algebra 4 SH

**CALCULUS 3 FOR SCIENCE/ENGINEERING**

Complete the following course:

MTH U341 Calculus 3 for Science and Engineering 4 SH

**ALGORITHMS AND DATA STRUCTURES**

Complete the following course with corresponding lab:

CS U215 Algorithms and Data Structures for Engineering 4 SH  
with CS U216 Lab for CS U215 1 SH

**Arts and Humanities**

Complete two courses from the “College of Engineering Arts and Humanities Requirements” on page 213. Also, complete one additional course from the following departments: ARC, ART, CJ, ECN, ENG, MUS, PHL, POL, PSY, SOC, or THE.

**ELECTRICAL ENGINEERING MAJOR REQUIREMENTS****First-Year Engineering**

Complete the following two courses:

GE U110 Engineering Design 4 SH  
GE U111 Engineering Problem Solving and Computation 4 SH

**General Engineering**

Complete the following three courses:

ECE U300 Introduction to Engineering Co-op Education 1 SH  
ECE U500 Professional Issues in Engineering 1 SH  
GE U100 Introduction to the Study of Engineering 1 SH

**Electrical Engineering Lab**

Complete the following course:

ECE U401 Introduction to Electrical and Computer Engineering Lab 1 SH

**Linear Circuits**

Complete the following course:

ECE U400 Linear Circuits 4 SH

**Electronics**

Complete the following course with corresponding lab:

ECE U402 Electronics 4 SH  
with ECE U403 Lab for ECE U402 1 SH

**Digital Logic Design**

Complete the following course with corresponding lab:

ECE U322 Digital Logic Design 4 SH  
with ECE U323 Lab for ECE U322 1 SH

**Linear Systems**

Complete the following course:

ECE U464 Linear Systems 4 SH

**Electromagnetic Fields and Waves**

Complete the following course with corresponding lab:

ECE U440 Electromagnetic Fields and Waves 4 SH  
with ECE U441 Lab for ECE U440 1 SH

**Noise and Stochastic Processes**

Complete the following course:

ECE U468 Noise and Stochastic Processes 4 SH

**Communication Systems**

Complete the following course:

ECE U572 Communications Systems 1 4 SH

**Electrical Engineering Technical Electives**

Complete four 4-SH-equivalent courses from the following list:

ECE U300 to ECE U699

**Capstone Design**

Complete the following two courses:

ECE U790 Electrical and Computer Engineering Capstone 1 4 SH  
ECE U792 Electrical and Computer Engineering Capstone 2 4 SH

## ELECTRICAL ENGINEERING GENERAL ELECTIVE REQUIREMENTS

Complete four 4-SH-equivalent, nonremedial, nonrepetitive courses from the following departments:

ACC, AFR, ARC, ART, ASL, BIO, CHE, CHM, CIN, CIV, CJ, CMN, CS, ECE, ECN, ED, ENG, ENT, ENV, FIN, GEO, HRM, HS, HST, IAF, INB, INT, IS, JRN, LIN, LNA, LNC, LNF, LNG, LNH, LNI, LNJ, LNL, LNM, LNR, LNS, MGT, MIM, MIS, MKT, MMS, MSC, MTH, MUS, PHL, PHY, POL, PSY, SCM, SOA, SOC, or THE.

## GPA REQUIREMENT

2.000 GPA required in the major

## GENERAL ELECTIVES

Additional courses taken beyond college and major course requirements to satisfy graduation credit requirements.

## COOPERATIVE EDUCATION

## UNIVERSITY-WIDE REQUIREMENTS

138 total semester hours required

Minimum 2.000 GPA required

## MECHANICAL AND INDUSTRIAL ENGINEERING

[www.coe.neu.edu/Depts/MIE](http://www.coe.neu.edu/Depts/MIE)

HAMEED METGHALCHI, ScD

*Professor and Chair*

EMANUEL MELACHRINOUDIS, PhD

*Associate Professor, Associate Chair, and Director of Industrial Engineering*

### WILLIAM LINCOLN SMITH PROFESSOR OF MECHANICAL ENGINEERING

Ahmed A. Busnaina, PhD

### DONALD W. SMITH PROFESSOR OF MECHANICAL ENGINEERING

John W. Cipolla Jr., PhD

### COLLEGE OF ENGINEERING DISTINGUISHED PROFESSOR

George G. Adams, PhD

## PROFESSORS

Thomas P. Cullinane, PhD

Surendra M. Gupta, PhD

Yiannis A. Levendis, PhD

Ronald R. Mourant, PhD

Hamid Nayeb-Hashemi, PhD

John N. Rossettos, PhD

Allen L. Soyster, PhD

Mohammad E. Taslim, PhD

Yaman Yener, PhD

Ibrahim Zeid, PhD

## ASSOCIATE PROFESSORS

Teiichi Ando, PhD

James C. Benneyan, PhD

Nasser S. Fard, PhD

Jacqueline A. Isaacs, PhD

Sagar V. Kamarthi, PhD

Gregory J. Kowalski, PhD

Constantinos Mavroidis, PhD

Sinan Muftu, PhD

Uichiro Narusawa, PhD

Ronald F. Perry, PhD

Jeffrey W. Ruberti, PhD

## ASSISTANT PROFESSOR

Grant Warner, PhD

## SENIOR RESEARCH SCIENTIST AND PROFESSOR EMERITUS

Welville B. Nowak, PhD

## PROFESSORS EMERITI

Alexander M. Gorlov, PhD

Thomas E. Hulbert, MS

Richard J. Murphy, PhD

The Department of Mechanical and Industrial Engineering offers two accredited programs leading to a Bachelor of Science in industrial engineering or a Bachelor of Science in mechanical engineering.

The overarching mission of the department is to organize the faculty, staff, curricula, facilities, and research programs to provide the highest-quality education for our students. At the undergraduate level, our goal is to provide rigorous, theoretically based but practice-oriented programs that effectively integrate classroom and laboratory instruction with the cooperative work experience. The educational objectives for both of our undergraduate degree programs are to: (1) educate students through a broad, theoretically based mechanical or industrial engineering curriculum; (2) support students in developing practical work skills involving current technology and technical tools, as well as an awareness of manufacturing, management and economic issues, and commonly accepted norms for professional conduct; (3) integrate academic learning with practice-oriented experience to promote professional development and career planning; (4) provide students with learning experiences that instill a passion for lifelong learning; (5) involve students in leadership and contributing roles in interactive team environments; (6) instruct students to be effective communicators with good interpersonal skills; and (7) integrate students' engineering course work with industrial, ethical, cultural, historical, and societal perspectives, leading to an appreciation of the broad educational objectives (as specified in the University's Academic Common Experience [ACE] goals).