

# ELECTRICAL ENGINEERING, BACHELOR OF SCIENCE

## Mission

The Electrical Engineering Program at Johns Hopkins is supported by faculty in the Department of Electrical and Computer Engineering who are committed to providing a rigorous educational experience that prepares students for further study and to professionally and ethically practice engineering in a competitive global environment. Electrical Engineering is concerned with a wide variety of topics in signals, systems and communications, photonics and optoelectronics, and computer engineering. The mission of the program is to provide students with a broad, integrated education in the fundamentals and advanced topics in computer engineering, basic sciences, mathematics, and humanities in an environment that fosters the development of analytical, computational, and experimental skills, and that involves students in design projects and research experiences; and to provide our electrical engineering graduates with the tools, skills and competencies necessary to understand and apply today's technologies and become leaders in developing and deploying tomorrow's technologies.

## Educational Objectives

The Program Educational Objectives (PEOs) for computer engineering (CE) at the Johns Hopkins University describe what CE graduates are expected to attain within a few years of graduation. The PEOs are determined in consultation with the Electrical and Computer Engineering External Advisory Committee and approved by the ECE faculty.

The educational objectives of the CE program are:

- Our graduates will become successful practitioners in engineering and other diverse careers.
- Some graduates will pursue advanced degree programs in engineering and other disciplines.

## Program Requirements

The Bachelor of Science degree in electrical engineering requires a minimum of one hundred and twenty-six (126) credits that must include:

**Forty-five (45) credits of ECE courses including the following:**

Code	Title	Credits
EN.520.123	Computational Modeling for Electrical and Computer Engineering	3
EN.520.142	Digital Systems Fundamentals	3
EN.520.214	Signals and Systems	4
EN.520.219	Introduction to Electromagnetics	3
EN.520.230	Mastering Electronics	2
EN.520.231	Mastering Electronics Laboratory	2
<b>Advanced Laboratory Courses in ECE<sup>1</sup></b>		<b>6</b>
<b>6 Additional Advanced Lab credits from approved list</b>		<b>6</b>
<b>Additional Required ECE Electives</b>		<b>16</b>
Total Credits		45

<sup>1</sup> Six (6) credits of advanced laboratory, design intensive, or senior design project courses from those listed on the degree planning checklist. Up to six (6) credits of computer science courses may be used to satisfy the 45-credit requirement. A GPA of at least 2.0 must be maintained in ECE courses. Courses in this group may not be taken Satisfactory/Unsatisfactory.

*Six (6) credits of "other engineering" courses (with an E designation) from KSAS or School of Engineering departments other than ECE or Applied Mathematics and Statistics or General Engineering (Note: Entrepreneurship and Management courses in the Center for Leadership Education CANNOT be counted as "other engineering courses"). Students must complete enough of the approved non-ECE advanced design labs so that they have at least twelve (12) credits of combined ECE and non-ECE advanced laboratory, design intensive, or senior design project courses. Courses in this group may not be taken Satisfactory/Unsatisfactory.*

Code	Title	Credits
<b>Mathematics Department or the Applied Mathematics and Statistics Department<sup>1</sup></b>		
AS.110.109	Calculus II (For Physical Sciences and Engineering)	4
AS.110.202	Calculus III	4
or AS.110.211	Honors Multivariable Calculus	
AS.110.201	Linear Algebra	4
or AS.110.212	Honors Linear Algebra	
AS.110.302	Differential Equations and Applications	4
EN.553.310	Probability & Statistics for the Physical Sciences & Engineering	4
& EN.553.311	and Probability and Statistics for the Biological Sciences and Engineering	
or EN.553.420	Introduction to Probability	
Total Credits		20

<sup>1</sup> Courses in this group may not be taken Satisfactory/Unsatisfactory. Elementary or precalculus courses such as AS.110.105 Precalculus or EN.553.111 Statistical Analysis I - are not acceptable.

Code	Title	Credits
<b>Basic Sciences</b>		
AS.171.101	General Physics: Physical Science Major I	4
or AS.171.107	General Physics for Physical Sciences Majors (AL)	
AS.171.102	General Physics: Physical Science Major II	4
or AS.171.108	General Physics for Physical Science Majors (AL)	
AS.173.111	General Physics Laboratory I	1
AS.173.112	General Physics Laboratory II	1
AS.030.101	Introductory Chemistry I	3
Additional N credits		3
Total Credits		16

- *Sixteen (16) credits of basic sciences* (physics, chemistry, biology, earth and planetary sciences), which must include AS.171.101 General Physics: Physical Science Major I-AS.171.102 General Physics: Physical Science Major II, AS.173.111 General Physics Laboratory I-AS.173.112 General Physics Laboratory II. Courses in this category may not be taken Satisfactory/Unsatisfactory.
- *At least five (5), three-credit courses in humanities and social sciences, plus two (2) additional credits in EN.660.400 Practical Ethics for*

Future Leaders and one (1) credit EN.520.404 Engineering solutions in a global, economic, environmental, and societal context. ECE students beginning prior to Fall 2018 will be permitted to fulfill this requirement by six (6), three credit courses, or by the guidelines provided above. The humanities and social sciences courses are one of the strengths of the academic programs at Johns Hopkins. They represent opportunities for students to appreciate some of the global and societal impacts of engineering, to understand contemporary issues, and to exchange ideas with scholars in other fields. Some of the courses will help students to communicate more effectively, to understand economic issues, or to analyze problems in an increasingly international world. The selection of courses should not consist solely of introductory courses, but should have both depth and breadth. This means that students should take at least three (3) courses in a specific area or theme, with at least one of them at an advanced level (300 level or higher).

- A programming language requirement must be met by taking EN.601.220 Intermediate Programming. This class can be used towards the "other engineering" category or can be used as one of the classes that counts towards the 45 ECE credit requirement.
- Two (2) writing intensive courses (at least 3 credits each) are required. The writing intensive courses may not be taken Satisfactory/Unsatisfactory and require a C- or better grade. Students may wish to consider a course in Technical Communications to fulfill one of the writing intensive requirements. The course EN.661.315 Culture of the Engineering Profession, is recommended by the ECE Faculty as a writing intensive course.

Additional details concerning advising and degree requirements are in the Electrical Engineering Advising Manual. The B.S. in Electrical Engineering degree program is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>.

The sample program below is very general. Sample programs with an emphasis on Signals, Systems, and Communications or Photonics and Optoelectronics can be found in the advising manual.

#### First Year

First Semester	Credits	Second Semester	Credits
AS.110.109	4	AS.171.102 or 108	4
AS.171.101 or 107	4	EN.601.220	4
AS.173.111	1	AS.173.112	1
EN.520.137	3	EN.520.142	3
EN.500.112	3	EN.520.123	3
	15		15

#### Second Year

First Semester	Credits	Second Semester	Credits
AS.110.202 or 211	4	AS.110.201	4
AS.030.101	3	EN.520.214	4
EN.520.219	3	EN.520.216	3
EN.520.230	2	ECE Elective 1	3
EN.520.231	2	AS.110.302	4
H&S 1	3		
	17		18

#### Third Year

First Semester	Credits	Second Semester	Credits
EN.553.310 or 420 <sup>1</sup>	4	EN.520.353	3
EN.520.344	3	ECE Elective 4	3

ECE Elective 2	3	Basic Science Elective (N)	3
ECE Elective 3	3	H&S 3	3
EN.660.400	2	H&S 4	3
EN.520.404	1		
	16		15

#### Fourth Year

First Semester	Credits	Second Semester	Credits
Advanced ECE Lab 1	3	Advanced Lab 3 <sup>2</sup>	3
Advanced ECE Lab 2	3	Advanced Lab 4 <sup>2</sup>	3
ECE Elective 5	3	Non-ECE Engineering Elective 2	3
Non-ECE Engineering Elective 1	3	ECE Elective 6	3
H&S 5	3	H&S 6	3
	15		15

Total Credits 126

- <sup>1</sup> EN.553.311 Probability and Statistics for the Biological Sciences and Engineering also fulfills req.
- <sup>2</sup> Can be fulfilled by ECE advanced lab or other engineering advanced lab from approved checklist.

## Learning Outcomes

Students graduating with a B.S. in computer engineering will have demonstrated:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Each student and faculty advisor must consider these objectives in planning a set of courses and projects that will satisfy degree requirements. The sample programs and the program checklist included in this advising manual illustrate course selections that will help students meet the program objectives.

Faculty and others will assess student performance to ensure that our educational objectives are met. Students will have opportunities to assess their own educational progress and achievements in several ways, including exit interviews and alumni surveys. Through regular review processes, including Academic Council departmental reviews, visits

by the departmental external advisory board, course evaluations, and ABET visits; students will have opportunities to discuss their educational experiences and expectations. The outcomes of these assessment processes will be used by the faculty to improve the content and delivery of the educational program.

The success of each student's program will depend on effective faculty advising. Every undergraduate student in the Electrical Engineering Program must follow a program approved by a faculty advisor.