Bachelor of Science in Electrical Engineering

Electrical Engineering (BSEE)

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The electrical engineering undergraduate curriculum begins with a solid foundation in math, science, English, circuits, signals and linear systems, electronics, electromagnetics, digital systems, and microelectronics. Adequate elective freedom is available to the student to allow specialization in one or more of five areas: systems and automation engineering, physical electronics, computer hardware systems, power and renewable energy, or data analytics engineering. Emphasis is placed on understanding principles through theoretical investigation and experimental verification. In addition, course work in General Education Skills and Ways of Knowing is required to assure a well-rounded program of study.

Students pursuing a BSEE degree are intended in their degree until Engineering Fundamental/foundational courses (I.E. Calculus I & II, Calculus-based University Physics I, Programming I, Chemistry I, and Engineering introductory courses) are completed.

Electrical Engineering Program Educational Objectives

The electrical engineering program seeks to prepare graduates who, after the first few years of their professional career, have:

1. established themselves as practicing engineering professionals in industry or government, or engaged in graduate study
2. demonstrated their ability to work successfully as members of a professional team and function effectively as responsible professionals
3. demonstrated their ability to adapt to new technology and career challenges

Student Outcomes

The electrical engineering student outcomes are as follows. Graduates must attain:

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.

Accreditation

The Bachelor of Science in Electrical Engineering is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org. (http://www.abet.org)

Requirements

Lower-Division General Education

Written Communication (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#written)	6
Oral Communication (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#oral)	3
Mathematics (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#math)	3
Language and Culture (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#language)	0-6
Information Literacy and Research (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#information)	3
Human Behavior (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#behavior)	3
Human Creativity (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#creativity)	3
Interpreting the Past (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#interpret)	3
Literature (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#literature)	3
Philosophy and Ethics (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#philosophy)	3
The Nature of Science (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#nature)	8
Impact of Technology (http://catalog.odu.edu/undergraduate/requirements-undergraduate-degrees/#impact)	3

The General Education requirements in information literacy and research, impact of technology, and philosophy and ethics are met through the major.

Upper-Division General Education

- Option A. Approved Minor, 12-24 credit hours; also second degree or second major
- Option B. Interdisciplinary Minor; 12 credit hours, (3 credit hours may be in the major area of study)
- Option C. An approved certification program such as teaching licensure (hours vary)
- Option D. Two Upper-Division Courses (6 credit hours) from outside the College of Engineering and Technology and are not required by the major.

Requirements for Graduation

Requirements for graduation include the following:

- Minimum of 120 credit hours.
- Minimum of 30 credit hours overall and 12 credit hours of upper-level courses in the major program from Old Dominion University.
- Minimum overall cumulative grade point average of C (2.00) in all courses taken.
- Minimum overall cumulative grade point average of C (2.00) in all courses taken toward the major.
- Minimum overall cumulative grade point average of C (2.00) in all courses taken toward a minor.
- Completion of ENGL 110C, ENGL 211C or ENGL 231C, and the writing intensive (W) course in the major with a grade of C or better. The W course must be taken at Old Dominion University.
- Completion of Senior Assessment.

Electrical Engineering

Electrical engineering majors must earn a grade of C or better in all 200-level ECE courses prior to taking the next course in the sequence.

Any ECE course registration issues are to be resolved with the ECE Academic Coordinator and Program Manager.

General Education	
Complete lower-division requirements	33-39
Complete upper-division requirements (minimum of 6 credit hours)	6
Electrical Engineering Major	
Complete electrical engineering departmental and major requirements as shown on the degree program guide	84
Total Credit Hours	**123-129**

Electrical Engineering Areas of Specialization

Students in the Bachelor of Science in Electrical Engineering degree program may focus their studies in one or more specialized areas by electing to take courses in systems and automation engineering, physical electronics, computer hardware systems, power and renewable energy, or data analytics engineering.

The systems and automation engineering area requires completion of four courses selected from the following: ECE 381, ECE 451, ECE 455, ECE 458, and ECE 461.

The physical electronics area requires completion of four courses selected from the following: ECE 403, ECE 454, ECE 464, ECE 471, ECE 472, ECE 473, and ECE 474.

The computer hardware systems area requires completion of four courses selected from the following: ECE 341, ECE 346, ECE 441, ECE 443, and ECE 483.

The power and renewable energy area requires completion of four courses selected from the following: ECE 303, ECE 403, ECE 404, ECE 405, ECE 408, ECE 461, and ECE 471.

The data analytics engineering area requires completion of the following four courses: ECE 346, ECE 350, ECE 445, and ECE 450.

Degree Program Guide

The Degree Program Guide is a suggested curriculum to complete this degree program in four years. It is just one of several plans that will work and is presented only as broad guidance to students. Each student is strongly encouraged to develop a customized plan in consultation with their academic advisor. Additional information can also be found in Degree Works.

Electrical Engineering (BSEE)*

Course	Title	Credit Hours
Freshman		
Fall		
ENGN 121	Introduction to Engineering and Technology	4
CHEM 121N	Foundations of Chemistry I Lecture	3
CHEM 122N	Foundations of Chemistry I Laboratory	1
MATH 211	Calculus I (Grade of C or better required)	4
ENGL 110C	English Composition (Grade of C or better required)	3
	Credit Hours	**15**
Spring		
ENGN 122	Computer Programming for Engineering	4
COMM 101R	Public Speaking	3
MATH 212	Calculus II (Grade of C or better required)	4
PHYS 231N	University Physics I	4
	Credit Hours	**15**
Sophomore		
Fall		
MATH 307 or MATH 280	Ordinary Differential Equations or Transfer Credit for Ordinary Differential Equations	3
ECE 201	Circuit Analysis I	3
ECE 241	Fundamentals of Computer Engineering	4
PHYS 232N	University Physics II	4
ENGL 211C or ENGL 231C	Writing, Rhetoric, and Research (Grade of C or better required) or Writing, Rhetoric, and Research: Special Topics	3
	Credit Hours	**17**
Spring		
ECE 202	Circuit Analysis II	3
ECE 287	Fundamental Electric Circuit Laboratory	2
ECE 304	Probability, Statistics, and Reliability	3
MATH 312 or MATH 285	Calculus III or Transfer Credit for Calculus III	4
Interpreting the Past Way of Knowing		3
	Credit Hours	**15**
Junior		
Fall		
ECE 302	Linear System Analysis	3
ECE 313	Electronic Circuits	4
ECE 332	Microelectronic Materials and Processes	3
ECE 461	Automatic Control Systems	3
Human Creativity Way of Knowing		3
	Credit Hours	**16**
Spring		
ECE 303	Introduction to Electrical Power	3
ECE 323	Electromagnetics	3
ECE 381	Introduction to Discrete-time Signal Processing	3
ECE 451	Communication Systems	3
Literature Way of Knowing		3
	Credit Hours	**15**
Senior		
Fall		
ECE 481W	Preparatory ECE Senior Design (Grade of C or better required)	3
Technical Elective **		3
Technical Elective **		3
ENMA 480	Ethics and Philosophy in Engineering Applications	3
Upper-Division General Education course		3
	Credit Hours	**15**

Spring		
ECE 482	ECE Senior Design	3
Technical Elective **		3
Technical Elective **		3
Human Behavior Way of Knowing		3
Upper-Division General Education course		3
	Credit Hours	**15**
	Total Credit Hours	**123**

* Does not include the University's General Education language and culture requirement. Additional hours may be required.

** Electrical Engineering students need four technical elective courses selected from one of two options: (1) four 400-level ECE technical elective courses; (2) three 400-level ECE technical elective courses and one 300-level ECE technical elective course or one approved 300- or 400-level CS/MATH/Engineering course.

Electrical Engineering (BSEE) Dual Major/Degree with Computer Engineering Major (BSCE)*

Course	Title	Credit Hours
Freshman		
Fall		
ENGN 121	Introduction to Engineering and Technology	4
CHEM 121N	Foundations of Chemistry I Lecture	3
CHEM 122N or CHEM 120	Foundations of Chemistry I Laboratory ** or Foundations of Chemistry I Laboratory for Online Degree Programs	1
MATH 211	Calculus I (Grade of C or better required)	4
ENGL 110C	English Composition (Grade of C or better required)	3
	Credit Hours	**15**
Spring		
ENGN 122	Computer Programming for Engineering	4
MATH 212	Calculus II (Grade of C or better required)	4
COMM 101R	Public Speaking	3
PHYS 231N	University Physics I	4
	Credit Hours	**15**
Sophomore		
Fall		
MATH 307 or MATH 280	Ordinary Differential Equations or Transfer Credit for Ordinary Differential Equations	3
ENGL 211C or ENGL 231C	Writing, Rhetoric, and Research (Grade of C or better required) or Writing, Rhetoric, and Research: Special Topics	3
ECE 201	Circuit Analysis I	3
PHYS 232N	University Physics II	4
CS 381	Introduction to Discrete Structures	3
Human Creativity Way of Knowing		3
	Credit Hours	**19**
Spring		
ECE 202	Circuit Analysis II	3
ECE 287	Fundamental Electric Circuit Laboratory	2
ECE 241	Fundamentals of Computer Engineering	4
CS 252	Introduction to Unix for Programmers	1
ECE 250	Object-Oriented Programming in C++ for Engineers	3
MATH 312 or MATH 285	Calculus III or Transfer Credit for Calculus III	4
	Credit Hours	**17**
Junior		
Fall		
ECE 302	Linear System Analysis	3
ECE 304	Probability, Statistics, and Reliability	3
ECE 461	Automatic Control Systems	3
ECE 341	Digital System Design	3
CS 261	Java for Programmers	1
Interpreting the Past Way of Knowing		3
	Credit Hours	**16**
Spring		
ECE 303	Introduction to Electrical Power	3
ECE 313	Electronic Circuits	4
ECE 346	Microcontrollers	3
ECE 381	Introduction to Discrete-time Signal Processing	3
CS 361	Data Structures and Algorithms	3
ECE 451	Communication Systems	3
	Credit Hours	**19**
Senior		
Fall		
ECE 342	Field Programmable Gate Arrays Design Laboratory	2
ECE 323	Electromagnetics	3
ECE 481W	Preparatory ECE Senior Design (Grade of C or better required)	3
ECE 443	Computer Architecture	3
ECE 332	Microelectronic Materials and Processes	3
ECE 355	Introduction to Networks and Data Communications	3
	Credit Hours	**17**
Spring		
ECE 482	ECE Senior Design	3
CS 350 or CS 330	Introduction to Software Engineering or Object-Oriented Design and Programming	3

CS 471	Operating Systems	3
ENMA 480	Ethics and Philosophy in Engineering Applications	3
Human Behavior Way of Knowing		3
Literature Way of Knowing		3
	Credit Hours	**18**
	Total Credit Hours	**136**

* Does not include the University's General Education language and culture requirement. Additional hours may be required.

** CHEM 120 is for online program students only.

The General Education requirements in information literacy and research, impact of technology, and philosophy and ethics are met through the major. The upper-division General Education requirement is met through a built-in minor in computer science and through the completion of a second major/degree.

Electrical & Computer engineering majors must earn a grade of C or better in all 200-level ECE courses and all CS courses prior to taking the next course in the sequence.

Any ECE course registration issues are to be resolved with the ECE Academic Coordinator and Program Manager. Students must have a 3.00 GPA or better and must obtain approval from their advisor and college dean to register for more than 18 hours in a semester.

The five-year plan is a suggested curriculum to complete this degree program in five years. It is just one of several plans that will work and is presented only as broad guidance to students. Each student is strongly encouraged to develop a customized plan in consultation with their academic advisor. Additional information can also be found in Degree Works.

Students seeking two degrees must complete a minimum of 150 credit hours.

Electrical Engineering (BSEE) Dual Major/Degree with Modeling & Simulation Engineering Major (BSCE)*

Course	Title	Credit Hours
Freshman		
Fall		
ENGN 121	Introduction to Engineering and Technology	4
CHEM 121N	Foundations of Chemistry I Lecture	3
CHEM 122N or CHEM 120	Foundations of Chemistry I Laboratory ** or Foundations of Chemistry I Laboratory for Online Degree Programs	1
MATH 211	Calculus I (Grade of C or better required)	4
ENGL 110C	English Composition (Grade of C or better required)	3
	Credit Hours	**15**
Spring		
MATH 212	Calculus II (Grade of C or better required)	4
ENGN 122	Computer Programming for Engineering	4
PHYS 231N	University Physics I	4
COMM 101R	Public Speaking	3
	Credit Hours	**15**
Sophomore		
Fall		
MATH 307 or MATH 280	Ordinary Differential Equations or Transfer Credit for Ordinary Differential Equations	3
ENGL 211C or ENGL 231C	Writing, Rhetoric, and Research (Grade of C or better required) or Writing, Rhetoric, and Research: Special Topics	3
ECE 201	Circuit Analysis I	3
PHYS 232N	University Physics II	4
CS 381	Introduction to Discrete Structures	3
Human Creativity Way of Knowing		3
	Credit Hours	**19**
Spring		
ECE 202	Circuit Analysis II	3
ECE 287	Fundamental Electric Circuit Laboratory	2
ECE 241	Fundamentals of Computer Engineering	4
ECE 250	Object-Oriented Programming in C++ for Engineers	3
MATH 312 or MATH 285	Calculus III or Transfer Credit for Calculus III	4
	Credit Hours	**16**
Junior		
Fall		
ECE 302	Linear System Analysis	3
ECE 304	Probability, Statistics, and Reliability	3
ECE 341	Digital System Design	3
ECE 461	Automatic Control Systems	3
CS 261	Java for Programmers	1
Interpreting the Past Way of Knowing		3
	Credit Hours	**16**
Spring		
ECE 313	Electronic Circuits	4
ECE 346	Microcontrollers	3
ECE 451	Communication Systems	3
ECE 381	Introduction to Discrete-time Signal Processing	3
ECE 306	Discrete System Modeling and Simulation	3
ECE 320	Continuous System Modeling and Simulation	3
	Credit Hours	**19**
Senior		
Fall		
ECE 323	Electromagnetics	3
ECE 481W	Preparatory ECE Senior Design (Grade of C or better required)	3

ECE 303	Introduction to Electrical Power	3
ECE 406	Computer Graphics and Visualization	3
ECE 348	Simulation Software Design	3
ECE 332	Microelectronic Materials and Processes	3
	Credit Hours	**18**
Spring		
ECE 482	ECE Senior Design	3
ENMA 480	Ethics and Philosophy in Engineering Applications	3
ENMA 410	Agile Project Management	3
Technical Elective ***		3
Literature Way of Knowing		3
Human Behavior Way of Knowing		3
	Credit Hours	**18**
	Total Credit Hours	**136**

* Does not include the University's General Education language and culture requirement. Additional hours may be required.

** CHEM 120 is for online program students only.

*** Electrical & Computer Engineering students pursuing the double major/degree need their final technical elective to be a 400-level ECE technical elective course.

The General Education requirements in information literacy and research, impact of technology, and philosophy and ethics are met through the major. The upper-division General Education requirement is met through the completion of a second major/degree.

Electrical & Computer engineering majors must earn a grade of C or better in all 200-level ECE courses and all CS courses prior to taking the next course in the sequence.

Any ECE course registration issues are to be resolved with the ECE Academic Coordinator and Program Manager. Students must have a 3.00 GPA or better and must obtain approval from their advisor and college dean to register for more than 18 hours in a semester.

The four-year plan is a suggested curriculum to complete this degree program in four years. It is just one of several plans that will work and is presented only as broad guidance to students. Each student is strongly encouraged to develop a customized plan in consultation with their academic advisor. Additional information can also be found in Degree Works.

Students seeking two degrees must complete a minimum of 150 credit hours.

Bachelor of Science in Physics (BS): Dual Degree with Electrical Engineering (BSEE)*

Course	Title	Credit Hours
Freshman		
Fall		
ENGN 121	Introduction to Engineering and Technology [1]	4
CHEM 121N	Foundations of Chemistry I Lecture	3
CHEM 122N	Foundations of Chemistry I Laboratory	1
MATH 211	Calculus I (Grade of C or better required)	4
ENGL 110C	English Composition (Grade of C or better required)	3
	Credit Hours	**15**
Spring		
ENGN 122	Computer Programming for Engineering	4
MATH 212	Calculus II (Grade of C or better required)	4
PHYS 261N or PHYS 231N or PHYS 226N	Advanced University Physics I or University Physics I or Honors: University Physics I	4
COMM 101R	Public Speaking	3
	Credit Hours	**15**
Sophomore		
Fall		
MATH 307 or MATH 280	Ordinary Differential Equations or Transfer Credit for Ordinary Differential Equations	3
CHEM 123N	Foundations of Chemistry II Lecture	3
CHEM 124N	Foundations of Chemistry II Laboratory	1
ECE 201	Circuit Analysis I	3
ENGL 211C or ENGL 231C	Writing, Rhetoric, and Research (Grade of C or better required) or Writing, Rhetoric, and Research: Special Topics	3
PHYS 262N or PHYS 232N or PHYS 227N	Advanced University Physics II or University Physics II or Honors: University Physics II	4
	Credit Hours	**17**
Spring		
ECE 202	Circuit Analysis II	3
ECE 287	Fundamental Electric Circuit Laboratory [2]	2
ECE 241	Fundamentals of Computer Engineering	4
PHYS 319	Analytical Mechanics	3
MATH 312 or MATH 285	Calculus III or Transfer Credit for Calculus III	4
	Credit Hours	**16**
Junior		
Fall		
ECE 302	Linear System Analysis	3
ECE 303	Introduction to Electrical Power	3
PHYS 323	Modern Physics	3
PHYS 355	Mathematical Methods of Physics	3
PHYS 425	Electromagnetism I [3]	3
	Credit Hours	**15**
Spring		
ECE 313	Electronic Circuits	4
ECE 381	Introduction to Discrete-time Signal Processing	3

ECE 323 or PHYS 453	Electromagnetics [4] or Electromagnetism II	3
PHYS 411 or PHYS 415 or PHYS 416 or PHYS 417		3
Literature Way of Knowing		3
	Credit Hours	**16**
Senior		
Fall		
ECE 304	Probability, Statistics, and Reliability	3
ECE 461	Automatic Control Systems	3
ECE Technical Elective I [5]		3
PHYS 452	Introduction to Quantum Mechanics	3
ENMA 480	Ethics and Philosophy in Engineering Applications [6]	3
	Credit Hours	**15**
Spring		
ECE 451	Communication Systems	3
PHYS 413	Methods of Experimental Physics	3
PHYS 456	Intermediate Quantum Mechanics [4]	3
PHYS 499W or PHYS 489W and PHYS 490W		3
Human Behavior Way of Knowing		3
	Credit Hours	**15**
Fifth Year		
Fall		
ECE 332	Microelectronic Materials and Processes	3
ECE 481W	Preparatory ECE Senior Design (Grade of C or better required to meet the University Writing Intensive requirement)	3
ECE Technical Elective II [5]		3
PHYS 420	Introductory Computational Physics	3
Human Creativity Way of Knowing		3
	Credit Hours	**15**
Spring		
ECE 482	ECE Senior Design	3
ECE Technical elective III [5]		3
ECE Technical elective IV [5]		3
PHYS 454	Thermal and Statistical Physics	3
Interpreting the Past Way of Knowing		3
	Credit Hours	**15**
	Total Credit Hours	**154**

* Does not include the University's General Education language and culture requirement. Additional hours may be required.

1 ENGN 121 satisfies both the Physics Approved Seminar requirement and the PHYS Information Literacy and Research requirement in the Physics curriculum.

2 ECE 287 satisfies the PHYS 303 requirement in the Physics curriculum.

3 PHYS 425 satisfies the Nonmajor Engineering Elective requirement in the Electrical Engineering curriculum.

4 PHYS 453 and PHYS 456 offered spring semester only.

5 Electrical Engineering students need four technical elective courses selected from one of two options: (1) four 400-level ECE technical elective courses; (2) three 400-level ECE technical elective courses and one 300-level ECE technical elective course or one approved 300- or 400-level CS/MATH/Engineering course.

6 ENMA 480 satisfies the PHYS Philosophy & Ethics requirement in the Physics curriculum.

The General Education requirements in information literacy and research, impact of technology, and philosophy and ethics are met through the Electrical Engineering major/degree. The upper-division General Education requirement is met through the completion of a second major/degree.

Electrical engineering majors must earn a grade of C or better in all 200-level ECE courses prior to taking the next course in the sequence.

Any ECE course registration issues are to be resolved with the ECE Academic Coordinator and Program Manager.

The five-year plan is a suggested curriculum to complete this degree program in five years. It is just one of several plans that will work and is presented only as broad guidance to students. Each student is strongly encouraged to develop a customized plan in consultation with their academic advisor. Additional information can also be found in Degree Works.

Linked Bachelor's/Master's Degree Programs

These are designed to allow qualified students to secure a space in a master's program available in the Frank Batten College of Engineering and Technology while they are still pursuing their undergraduate degrees. An eligible student can choose a master's program in the same discipline as his/her bachelor's program or in a complementary discipline. Subject to the approval of the undergraduate and graduate program directors, a student enrolled in a linked program can count up to six credit hours of course work towards both the undergraduate and the graduate degrees. Full-time students may be able to complete the requirements for the bachelor's degree in four years and the master's degree in one additional year. Students in linked programs must earn a minimum of 150 credit hours (120 discrete credit hours for the undergraduate degree and 30 discrete credit hours for the graduate degree).

Students who are matriculated in an undergraduate major in the Frank Batten College of Engineering and Technology with a GPA of at least 3.00 overall and 3.00 in the major are eligible to apply for admission to a linked bachelor's/master's program. Transfer students who desire to be admitted to a linked program at the time they join an undergraduate major at Old Dominion University are eligible to apply if their overall GPA at their previous institution is 3.25 or higher. Prerequisite courses may be required for engineering technology majors to pursue a master's degree in engineering.

Continuance in a linked bachelor's/master's program requires maintenance of a GPA of 3.00 or higher overall and in the major.

Bachelor-to-PhD Programs

For a select number of exceptionally well-qualified students, the college has established a linked doctoral program that enables students to be admitted directly into the PhD program upon completion of the baccalaureate degree. A select number of exceptionally well-qualified students can be admitted to the Bachelor/PhD program in their junior year while they are pursuing one of the undergraduate programs at Old Dominion University. This program encourages admitted students to work closely with faculty members and pursue a research experience. Just as in the linked Bachelor/MS program, six credit hours of graduate course work may again be counted towards the undergraduate degree and doctoral course work mentioned above for the Bachelor/PhD program. For linked bachelor's to doctoral programs, students must earn a minimum of 198 credit hours (120 discrete credit hours for the undergraduate degree and 78 discrete credit hours for the graduate

degree). Students in these programs must maintain a GPA of 3.50 or better throughout their bachelor's and doctoral studies.

The student may opt to obtain the master's degree along the way to the doctorate. To obtain the master's degree, the student must utilize the six graduate credits obtained as part of their undergraduate program, use 18 credits of the graduate course work that is part of the PhD, and work with the Graduate Program Director to plan the final 6 credits.