

APPLIED ELECTROMAGNETICS MAJOR

Program Curriculum

Code	Title	Credits
Degree Core Requirements		
ECE 1004	Introduction to ECE Concepts (C)	3
ECE 2024	Circuits and Devices (C)	3
ECE 2544	Fundamentals of Digital Systems (C)	3
ECE 2214	Physical Electronics (C)	3
ECE 2714	Signals and Systems (C)	3
ECE 2804	Integrated Design Project (C)	2
ECE 3004	AC Circuit Analysis (C-)	3
ECE 3074	AC Circuit Analysis Laboratory (C-)	1
ECE 3105	Electromagnetic Fields (C-)	3
Subtotal		24
Major Requirements		
ECE 2514	Computational Engineering (C)	3
ECE 2564	Embedded Systems (C)	3
ECE 3106	Electromagnetic Fields	3
ECE 3104	Introduction to Space Systems and Technologies	3
or ECE 3134	Introduction to Optoelectronics	
or ECE 3604	Introduction to RF and Microwave Engineering	
ECE 3614	Introduction to Communication Systems	3
Restricted Electives		
Select two restricted electives from the list below.		6
Subtotal		21
Additional Course Requirements		
MATH 2114	Introduction to Linear Algebra	3
MATH 2204	Introduction to Multivariable Calculus	3
STAT 4714	Probability and Statistics for Electrical Engineers	3
Select one Math elective from list below.		3
Subtotal		12
Secondary Focus Area Requirements		
See secondary focus area requirements below.		9
Subtotal		9
Free Electives		
Select remaining credits required for the degree:		10
Subtotal		10
Pathways to General Education		
<i>Pathways Concept 1 - Discourse</i>		
ENGL 1105	First-Year Writing (1F)	3
ENGL 1106	First-Year Writing (1F)	3
Select one of the following:		6
ECE 4805 & ECE 4806	Senior Design Project and Senior Design Project (1A ; C-)	
ENGE 4735 & ENGE 4736	Interdisciplinary Design Capstone and Interdisciplinary Design Capstone	
<i>Pathways Concept 2 - Critical Thinking in the Humanities</i>		
Select six hours in Pathway 2 (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G02)		6

<i>Pathways Concept 3 - Reasoning in the Social Sciences</i>		
Select six hours in Pathway 3 (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G03)		6
<i>Pathways Concept 4 - Reasoning in the Natural Sciences</i>		
PHYS 2305	Foundations of Physics	4
PHYS 2306	Foundations of Physics	4
<i>Pathways Concept 5 - Quantitative and Computational Thinking</i>		
MATH 1225	Calculus of a Single Variable (5F ; C-)	4
MATH 1226	Calculus of a Single Variable (5F)	4
MATH 2214	Introduction to Differential Equations (5A ; C-)	3
<i>Pathways Concept 6 - Critique and Practice in Design and the Arts</i>		
Select three hours in Pathway 6a (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G06A)		3
ENGE 1215	Foundations of Engineering	4
& ENGE 1216	and Foundations of Engineering (6D ; C-)	
<i>Pathways Concept 7 - Critical Analysis of Identity and Equity in the United States</i>		
If Pathways 7 is double counted with another course, these credit hours will be free elective.		3
Subtotal		53
Total Credits		129

Secondary Focus Requirement

The ECE secondary focus requirement can be completed in one of two ways:

Focus Areas within ECE

The ECE secondary focus requirement consists of 3 ECE courses (9 credits) at the 3xxx level, 4xxx level, or 5xxx level where at least one course (3 credits) is at the 4xxx or 5xxx level. **None of the 3 courses can duplicate a course from the student's major.** All courses used for secondary focus must be taken on an A-F basis. For purposes of satisfying the secondary focus requirements, the sum of the number of hours taken from ECE 4974 Independent Study and ECE 4994 Undergraduate Research cannot exceed 6 credits.

The following courses are also included in the secondary focus:

Code	Title	Credits
AOE 4654	Space Weather: The Solar Wind and Magnetosphere	3
AOE 4674	Upper Atmosphere/Ionosphere Space Weather	3
CS 3214	Computer Systems	3
CS 4224	Linux Kernel Programming	3
CS 4264	Principles of Computer Security	3
CS 4504	Computer Organization	3
CS 4824	Machine Learning	3

The following courses **cannot** be used toward secondary focus:

Code	Title	Credits
ECE 3054	Electrical Theory	3
ECE 3074	AC Circuit Analysis Laboratory	1
ECE 3254	Industrial Electronics	3
ECE 3274	Electronic Circuits Laboratory II	1
ECE 3354	Electric Power Engineering Laboratory	1

ECE 3524	Introduction to Unix for ECE	2
ECE 4944	Cybersecurity Seminar	1

Individualized Secondary Focus

(Must be preapproved by ECE Department)

Electrical and computer engineering has applications across a wide variety of fields, such as medicine, human-computer interaction, finance, and entertainment. People with ECE degrees can be entrepreneurs, patent lawyers, policy makers, and business executives. The individualized secondary focus helps students pursue these interests. This option can be used in place of a pre-defined, in-department secondary focus.

The individualized secondary focus typically is pursued via an already defined university-approved program such as a degree, major, minor, or certificate that the student has declared. Students are encouraged to select courses from these programs, subject to the guidelines below.

- To begin this process, students must first meet with their academic advisor.
- The student must complete a brief proposal form describing the expected added value to their major. This includes a narrative about how these courses support the student's career goals and ability to achieve their professional aspirations. This proposal must be approved by the Director of Undergrad Program or designee.
- Individualized secondary focus plans must include 3 courses within the following parameters:
 - None of the courses may duplicate the student's ECE major requirements.
 - None of the courses can be at the 1xxx level (1xxx courses required for university-approved programs, e.g. minors, can be used for a student's free electives).
 - A maximum of one course can be at the 2xxx level, and only if it is a requirement of a university approved program, or if the course is a prerequisite to one or more of the other two courses in the individualized secondary focus.
 - A minimum of one course must be at the 4xxx level.
- If the set of courses is part of an already defined university program, the student should attach documentation to the proposal form.
- If the set of three courses are not part of an already defined university-approved program, the student must also obtain written approval from the department that houses the courses.
- It is the student's responsibility to ensure that the set of courses is available to be taken in a timely manner. The ECE department is not responsible for changes of programs elsewhere in the university.

Restricted Electives

Code	Title	Credits
ECE 3104	Introduction to Space Systems and Technologies	3
ECE 3134	Introduction to Optoelectronics	3
ECE 3204	Analog Electronics	3
ECE 3604	Introduction to RF and Microwave Engineering	3
ECE 4104	Microwave and RF Engineering	4
ECE 4114	Antennas	3
ECE 4124	Radio Wave Propagation	3
ECE 4134	Photonics	3
ECE 4144	Optical Systems	3

ECE 4154	Space Weather: The Solar Wind and Magnetosphere	3
ECE 4164	Introduction to Global Positioning System (GPS) Theory and Design	4
ECE 4174	Upper Atmosphere/Ionosphere Space Weather	3
ECE 4194	Engineering Principles of Remote Sensing	3
ECE 4205	Electronic Circuit Design	3
ECE 4220	Analog Integrated Circuit Design	3
ECE 4605	Radio Engineering	3
ECE 4644	Satellite Communications	3
ECE 4974	Independent Study	1-19
or ECE 4994	Undergraduate Research	

Math Elective

Code	Title	Credits
MATH 2534	Introduction to Discrete Mathematics	3
MATH 3034	Introduction to Proofs	3
MATH 3214	Calculus of Several Variables	3
MATH 3414	Numerical Methods	3
MATH 4445	Introduction to Numerical Analysis	3
MATH 4446	Introduction to Numerical Analysis	3
MATH 4564	Operational Methods for Engineers	3
MATH 4574	Vector and Complex Analysis for Engineers	3

General Information about Checksheet

Course offerings are subject to change and the availability of sufficient resources. Students should confirm course offerings in advance with their department.

Graduation Requirements

Each student must complete at least 129 semester credit hours with a minimum overall GPA of 2.00 and a minimum in-major GPA of 2.00. In determining the Applied Electromagnetics in-major GPA, all ECE courses plus ENGE 4735 and ENGE 4736, including repeats, are used.

Change of Major Requirements

Please see: <https://eng.vt.edu/em> (<https://eng.vt.edu/em/>)

Foreign Language Requirements

Students must have had 2 years of a foreign language in high school or one year at the college level (6 credit hours) of the same language. College-level credits used to meet this requirement do not count towards the degree.

Satisfactory Progress Towards Degree

University Policy 91 outlines university-wide minimum criteria to determine if students are making satisfactory progress towards the completion of their degrees. The ECE Department fully supports this policy. Specific expectations for satisfactory progress for BSCPE and BSEE majors are as follows:

- Each student must meet the minimum University-wide criteria as described in Policy 91 and summarized in the Undergraduate Catalog (under Academic Policies)
- Upon completing 2 semesters in ECE, students must have satisfactorily completed ECE 2024 Circuits and Devices, ECE 2514

Computational Engineering, ECE 2544 Fundamentals of Digital Systems, MATH 2214 Introduction to Differential Equations, and PHYS 2306 Foundations of Physics

- Upon completing 3 semesters in ECE, students must have satisfactorily completed ECE 2804 Integrated Design Project.
- Upon attempting 90 credits, BSCPE and BSEE students must have successfully completed 33 credits of in-major courses and have 2.0 overall and in-major GPAs. (The BSCPE and BSEE in-major GPA includes all ECE courses, including repeats).

Grade Requirement for Core Courses

Students must earn a C or higher in all ECE core courses: ECE 1004 Introduction to ECE Concepts, ECE 2024 Circuits and Devices, ECE 2214 Physical Electronics, ECE 2514 Computational Engineering, ECE 2544 Fundamentals of Digital Systems, ECE 2564 Embedded Systems, ECE 2714 Signals and Systems, and ECE 2804 Integrated Design Project.

Statement of Prerequisites

Pre-requisites for each course are listed. In general, all ECE courses require a C- or better in prerequisite courses. Students must earn a C or higher in all ECE core courses (listed above). There are no hidden prerequisites in this program of study. Prerequisites may change from what is indicated. Be sure to consult the Timetable of Classes or check with your advisor for the most current requirements.

Pathways to General Education (Pathways)

Consult the pathways courses table: <https://www.pathways.prov.vt.edu/about/table.html>. Pathways courses need to be completed prior to graduation.

Roadmap

Course	Title	Credits
First Year		
Fall Semester		
ECE 1004	Introduction to ECE Concepts (C)	3
ENGL 1105	First-Year Writing	3
MATH 1225	Calculus of a Single Variable (C-)	4
ENGE 1215	Foundations of Engineering (C-)	2
Pathways 2 or 3 or 6a		3
Credits		15
Spring Semester		
ENGL 1106	First-Year Writing	3
MATH 1226	Calculus of a Single Variable	4
PHYS 2305	Foundations of Physics	4
ENGE 1216	Foundations of Engineering (C-)	2
MATH 2114	Introduction to Linear Algebra (C-)	3
Credits		16
Second Year		
Fall Semester		
MATH 2214	Introduction to Differential Equations (C-)	3
PHYS 2306	Foundations of Physics (C-)	4
ECE 2024	Circuits and Devices (C)	3
ECE 2514	Computational Engineering (C)	3
ECE 2544	Fundamentals of Digital Systems (C)	3
Credits		16
Spring Semester		
MATH 2204	Introduction to Multivariable Calculus (C-)	3
ECE 2214	Physical Electronics (C)	3

ECE 2564	Embedded Systems (C)	3
ECE 2714	Signals and Systems (C)	3
ECE 2804	Integrated Design Project (C)	2
Pathways 2 or 3 or 6a		3
Credits		17

Third Year		
Fall Semester		
ECE 3004	AC Circuit Analysis (C-)	3
ECE 3074	AC Circuit Analysis Laboratory (C-)	1
ECE 3105	Electromagnetic Fields (C-)	3
Math Elective from list		3
STAT 4714	Probability and Statistics for Electrical Engineers	3
Secondary Focus Area course (see list)		3
Credits		16

Spring Semester		
ECE 3106	Electromagnetic Fields	3
ECE 3104 or ECE 3134 or ECE 3604	Introduction to Space Systems and Technologies or Introduction to Optoelectronics or Introduction to RF and Microwave Engineering	3
Secondary Focus Area course (see list)		3
Secondary Focus Area course (see list)		3
Free Electives		3
Pathways 2 or 3 or 6a		3
Credits		18

Fourth Year		
Fall Semester		
ECE 4805	Senior Design Project (C-)	3
Restricted Electives		3
ECE 3614	Introduction to Communication Systems	3
Pathways 2 or 3 or 6A		3
Free Elective		3
Credits		15

Spring Semester		
ECE 4806	Senior Design Project	3
Restricted Electives		3
Pathways 2 or 3 or 6a		3
Pathways 7 or Free Elective (if Pathways 7 double counted)		3
Free Elective		4
Credits		16
Total Credits		129

Restricted Electives

Code	Title	Credits
ECE 3104	Introduction to Space Systems and Technologies	3
ECE 3134	Introduction to Optoelectronics	3
ECE 3204	Analog Electronics	3
ECE 3604	Introduction to RF and Microwave Engineering	3
ECE 4104	Microwave and RF Engineering	4
ECE 4114	Antennas	3
ECE 4124	Radio Wave Propagation	3
ECE 4134	Photonics	3
ECE 4144	Optical Systems	3
ECE 4154	Space Weather: The Solar Wind and Magnetosphere	3
ECE 4164	Introduction to Global Positioning System (GPS) Theory and Design	4
ECE 4174	Upper Atmosphere/Ionosphere Space Weather	3
ECE 4194	Engineering Principles of Remote Sensing	3

ECE 4205	Electronic Circuit Design	3
ECE 4220	Analog Integrated Circuit Design	3
ECE 4605	Radio Engineering	3
ECE 4644	Satellite Communications	3
ECE 4974	Independent Study	1-19
or ECE 4994	Undergraduate Research	

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Code	Title	Credits
MATH 2534	Introduction to Discrete Mathematics	3
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MATH 3214	Calculus of Several Variables	3
MATH 3414	Numerical Methods	3
MATH 4445	Introduction to Numerical Analysis	3
MATH 4446	Introduction to Numerical Analysis	3
MATH 4564	Operational Methods for Engineers	3
MATH 4574	Vector and Complex Analysis for Engineers	3