NETWORKING & CYBERSECURITY MAJOR

Program Curriculum

Credits Required for graduation: 131

Code	Title	Credits
Degree Core Requirements		
ECE 1004	Introduction to ECE Concepts (C)	3
ECE 2024	Circuits and Devices (C)	3
ECE 2514	Computational Engineering (C)	3
ECE 2544	Fundamentals of Digital Systems (C)	3
ECE 2564	Embedded Systems (C)	3
ECE 2804	Integrated Design Project (C)	2
ECE 3514	Data Structures & Algorithms (C-)	3
ECE 3574	Applied Software Design (C-)	3
Subtotal		23
Major Requirements		
ECE 2214	Physical Electronics (C)	3
ECE 2714	Signals and Systems (C)	3
ECE 3504	Principles of Computer Architecture (C-)	3
ECE 3564	Introduction to Computer Networking (C-)	3
ECE 4564	Network Application Design	3
ECE 4560	Computer and Network Security Fundamentals	3
CS 4264	Principles of Computer Security	3
Subtotal		21
Additional Course Requirements		
MATH 2114	Introduction to Linear Algebra (C-)	3
MATH 2204	Introduction to Multivariable Calculus	3
STAT 4714	Probability and Statistics for Electrical Engineers (C-)	3
MATH 2534	Introduction to Discrete Mathematics	3
Subtotal		12
Secondary Focus Area Requirements		
See secondary focus area requirements below.		9
Subtotal		9
Free Elective Credits		
Select remaining credits required for the degree:		10
Subtotal		10
Pathways to General Education		
Pathways Concept 1 - Discourse		
ENGL 1105	First-Year Writing (1F)	3
ENGL 1106	First-Year Writing (1F)	3
ECE 4805 & ECE 4806	Senior Design Project and Senior Design Project (1A)	6
Pathways Concept 2 - Critical Thinking in the Humanities		
Select six hours in Pathway 2 (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G02)		6
Pathways Concept 3 - Reasoning in the Social Sciences		
Select six hours in Pathway 3 (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G03)		6
Pathways Concept 4 - Reasoning in the Natural Sciences		
PHYS 2305	Foundations of Physics	4
PHYS 2306	Foundations of Physics	4
Pathways Concept 5 - Quantitative and Computational Thinking		
MATH 1225	Calculus of a Single Variable (5F)	4
MATH 1226	Calculus of a Single Variable (5F)	4
MATH 2214	Introduction to Differential Equations (5A)	3
Pathways Concept 6 - Critique and Practice in Design and the Arts		
Select three credits in Arts Pathway 6a (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G06A)		3
ENGE 1215 & ENGE 1216	Foundations of Engineering and Foundations of Engineering (6D)	4
Pathways Concept 7 - Critical Analysis of Identity and Equity in the United States		
Pathways 7 should be double counted with either Pathways 2, 3 or 6a to avoid taking any additional credit hours.		3
Subtotal		53
Total Credits		**128**

Secondary Focus Requirement

Focus Areas Within ECE

The courses listed below are grouped into suggested ECE focus areas. Students are encouraged to choose 3 courses from a single focus area that is not their chosen major. Students have the flexibility to choose any 3 ECE courses (9 credits) at the 3xxx level or 4xxx level to meet the secondary focus requirement as long as at least one course (3 credits) is at the 4xxx level. **None of the 3 courses can duplicate a course from the student's major. Actual course offerings will be based on sufficient resources, including faculty availability and student demand.** Refer to the University's on-line timetable of classes for specific course availability information and prerequisite. Note: All ECE courses require a **C- or better** in prerequisite courses unless a C or better is noted on the checksheet.

Chip-Scale Integration

Code	Title	Credits
ECE 3004	AC Circuit Analysis	3
ECE 4514	Digital Design II	4
ECE 4540	VLSI Circuit Design	3

Controls, Robotics, and Autonomy

Code	Title	Credits
ECE 3004	AC Circuit Analysis	3
ECE 3105	Electromagnetic Fields	3
ECE 3704	Continuous and Discrete System Theory	3
ECE 3714	Introduction to Control Systems	3
ECE 4524	Artificial Intelligence and Engineering Applications	4
ECE 4580	Digital Image Processing	3
ECE 4704	Principles of Robotics Systems	3

Machine Learning

Code	Title	Credits
ECE 4424/ CS 4824	Machine Learning	3
ECE 4524	Artificial Intelligence and Engineering Applications	4
ECE 4525	Video Game Design and Engineering	3

ECE 4554	Introduction to Computer Vision	3
ECE 4580	Digital Image Processing	3

Software Systems

Code	Title	Credits
ECE 4524	Artificial Intelligence and Engineering Applications	4
ECE 4525	Video Game Design and Engineering	3
ECE 4550	Real-Time Systems	3
ECE 4574	Large-Scale Software Development for Engineering Systems	3

Communications and Networking

Code	Title	Credits
ECE 3004	AC Circuit Analysis	3
ECE 3105	Electromagnetic Fields	3
ECE 3564	Introduction to Computer Networking	3
ECE 3614	Introduction to Communication Systems	3
ECE 3704	Continuous and Discrete System Theory	3
ECE 4624	Digital Signal Processing And Filter Design	3
ECE 4634	Digital Communications	3

Energy and Power Electronic Systems

Code	Title	Credits
ECE 3004	AC Circuit Analysis	3
ECE 3105	Electromagnetic Fields	3
ECE 3204	Analog Electronics	3
ECE 3304	Introduction to Power Systems	3
ECE 3704	Continuous and Discrete System Theory	3
ECE 4205	Electronic Circuit Design	3
ECE 4224	Power Electronics	3
ECE 4334	Power System Analysis and Control	3

Micro/Nanosystems

Code	Title	Credits
ECE 3004	AC Circuit Analysis	3
ECE 3105	Electromagnetic Fields	3
ECE 3204	Analog Electronics	3
ECE 3214	Semiconductor Device Fundamentals	3
ECE 3614	Introduction to Communication Systems	3
ECE 4205	Electronic Circuit Design	3
ECE 4220	Analog Integrated Circuit Design	3
ECE 4234	Semiconductor Processing	3
ECE 4254	Principles of Electronics Packaging	3

Photonics

Code	Title	Credits
ECE 3004	AC Circuit Analysis	3
ECE 3105	Electromagnetic Fields	3
ECE 3106	Electromagnetic Fields	3
ECE 3134	Introduction to Optoelectronics	3
ECE 3614	Introduction to Communication Systems	3
ECE 4134	Photonics	3
ECE 4144	Optical Systems	3

Radio Frequency and Microwave

Code	Title	Credits
ECE 3004	AC Circuit Analysis	3
ECE 3105	Electromagnetic Fields	3
ECE 3106	Electromagnetic Fields	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 4220	Analog Integrated Circuit Design	3
ECE 4605	Radio Engineering	3

Space Systems

Code	Title	Credits
ECE 3004	AC Circuit Analysis	3
ECE 3104	Introduction to Space Systems and Technologies	3
ECE 3105	Electromagnetic Fields	3
ECE 3106	Electromagnetic Fields	3
ECE 3614	Introduction to Communication 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 4194	Engineering Principles of Remote Sensing	3
ECE 4205	Electronic Circuit Design	3
ECE 4644	Satellite Communications	3

Other ECE Options

(Actual course offerings will be based on sufficient resources)

Code	Title	Credits
ECE 4324	Microgrids	3
ECE 4354	Power System Protection	3
ECE 4424	Machine Learning	3
ECE 4444	Technological Singularity	3
ECE 4504	Computer Organization	3
ECE 4530	Hardware-Software Codesign	3
ECE 4534	Embedded System Design	4
ECE 4984	Special Study (Topics vary - See timetable for options)	1-19

Independent Studies and Undergraduate Research

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.

Code	Title	Credits
ECE 4974	Independent Study	1-19
ECE 4994	Undergraduate Research	1-19

Instructors and students must complete the College of Engineering Undergraduate Research/Independent Study Form (https://eng.vt.edu/academics/undergraduate-students/resources-support/undergraduate-research-independent-study.html).

Deadline to submit form is last day to add classes.

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.

1. To begin this process, students must first meet with their academic advisor.
2. 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.
3. Individualized secondary focus plans must include 3 courses within the following parameters:
   a. None of the courses may duplicate the student's ECE major requirements.
   b. 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).
   c. 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.
   d. A minimum of one course must be at the 4xxx level.
4. If the set of courses is part of an already defined university program, the student should attach documentation to the proposal form.
5. 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.
6. 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.

Graduation Requirements

Each student must complete at least 131 semester credit hours with a minimum overall GPA of 2.00 and a minimum in-major GPA of 2.00. In determining the Networking & Cybersecurity in-major GPA, all ECE courses, including repeats, are used.

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.

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.

Electives

The Networking & Cybersecurity Major requires 9 hours of free electives. Only free electives may be taken under the P/F grading option. Students are encouraged to use free elective credits to provide depth in their major or secondary focus.

Secondary Focus

The Networking & Cybersecurity Major requires 9 credits for a secondary focus area. Students have the flexibility to choose any 3 ECE courses (9 credits) at the 3xxx level or 4xxx level to meet the secondary focus requirements as long as at least one course (3 credits) is at the 4xxx level and the courses do not duplicate major courses. Alternatively, students may seek an approved individualized secondary focus. See the requirements below for more information.

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

Students must earn a C or higher in the following ECE 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, 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 the ECE 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.

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	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	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 3504	Principles of Computer Architecture (C-)	3
ECE 3514	Data Structures & Algorithms (C-)	3
STAT 4714	Probability and Statistics for Electrical Engineers (C-)	3
Secondary Focus Area course (see list)		3
Free Elective		3
	Credits	**15**
Spring Semester		
ECE 3574	Applied Software Design (C-)	3
ECE 3564	Introduction to Computer Networking (C-)	3
Secondary Focus Area course (see list)		3
Secondary Focus Area course (see list)		3
Pathways 2 or 3 or 6A		3
Free Elective		3
	Credits	**18**
Fourth Year		
Fall Semester		
ECE 4805	Senior Design Project (C-)	3
ECE 4564	Network Application Design	3
MATH 2534	Introduction to Discrete Mathematics	3
Pathways 2 or 3 or 6A		3
Pathways 2 or 3 or 6A		3
	Credits	**15**
Spring Semester		
ECE 4806	Senior Design Project	3
ECE 4560	Computer and Network Security Fundamentals	3
CS 4264	Principles of Computer Security	3
Pathways 7 or Free Elective (if Pathways 7 double counted)		3
Free Elective		4
	Credits	**16**
	Total Credits	**128**