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<tr>
<td>CHEM 1035 General Chemistry</td>
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<td>ENGL 1106 First-Year Writing</td>
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<td>CHEM 1045 General Chemistry Lab</td>
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<td>MATH 1226 Calculus of a Single Variable</td>
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<td>ENGL 1105 First-Year Writing</td>
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<td>PHYS 2305 Foundations of Physics I</td>
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<td>MATH 1225 Calculus of a Single Variable (C-)</td>
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<td>Pre: ENGE 1215</td>
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<td>ECE 1004(1) Introduction to ECE Concepts (C)</td>
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<tr>
<td>MATH 2214 Introduction to Differential Equations (C-)</td>
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<td>MATH 2204 Introduction to Multivariable Calculus</td>
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<td>PHYS 2306 Foundations of Physics I</td>
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<td>ECE 2214(1) Physical Electronics (C)</td>
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<td>ECE 2024(1) Circuits and Devices (C)</td>
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<td>ECE 2564(1) Embedded Systems (C)</td>
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<td>Pre: 1004, (MATH 2114 or MATH 2114H or MATH 2405H), MATH 2214, PHYS 2306</td>
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<td>ECE 2514(1) Computational Engineering (C)</td>
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<td>ECE 2714(1) Signals and Systems (C)</td>
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<td>Pre: 2024, 2514, 2544, MATH 2214, Co: 2564</td>
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<td>ECE 2544(1) Fundamentals of Digital Systems (C)</td>
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<td>ECE 2804(1) Integrated Design Project (C)</td>
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<td>Pre: 1004, ENGL 1106 or ENGL 1204H, Co: 2024, 2514</td>
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<td>ECE 3004(2) AC Circuit Analysis</td>
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<td>Pre: 2704 or (2714, 2804)</td>
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<td>ECE 2574(1) Data Structure and Algorithms (C-)</td>
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<td>ECE 3074(2) AC Circuit Analysis Lab</td>
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<td>Pre: 2074 or 2804, Co: 3004</td>
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<td>ECE 3544(1) Digital Design I</td>
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<td>ECE 3574(2) Applied Software Design (C-)</td>
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<td>Pre: 2574 or 3514</td>
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<td>STAT 4714 Probability and Statistics for Electrical Engineers</td>
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<td>Free Elective</td>
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<tr>
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<td>ECE 4806(1) Senior Design Project</td>
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<td>See timetable for prerequisites</td>
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<td>Pre: 4805</td>
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<tr>
<td>ECE 4540(2) VLSI Circuit Design</td>
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<td>ECE 4514(2) Digital Design II</td>
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<td>Pre: (2504, 2204) or (2544, 2214, 2804)</td>
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<td>Pre: 3544</td>
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<td>MATH 2534 Introduction to Discrete Math</td>
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<td>Pre: CS 1114 or ECE 1574 or ECE 1004</td>
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**ECE 2022 DRAFT CHECKSHEET**
**General Information about Checksheet:** Superscripted annotation after the course number (1) indicates core course of the degree while (2) indicates courses associated with the major. Additionally, (F, S, SI, SII) in credits column indication terms when a course is expected to be offered. 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**
Consult the Pathways Course listing ([https://www.pathways.prov.vt.edu/about/table.html](https://www.pathways.prov.vt.edu/about/table.html)) for more information. Pathways courses must be completed prior to graduation.

**Pathways 1F: Discourse (6 hrs)**
- ENGL 1105 (3)
- ENGL 1106 (3)

**Pathways 1A: Discourse (3 hrs)**
- ECE 2804/4805/4806 (2/3/3)

**Pathways 2: Critical Thinking in the Humanities (6 hrs)**
- (3)

**Pathways 3: Reasoning in the Social Sciences (6 hrs)**
- (3)

**Pathways 4: Reasoning in Natural Sciences (6 hrs)**
- PHYS 2305 (4)
- PHYS 2306 (4)

**Pathways 5F: Quantitative and Computational Thinking (6 hrs)**
- MATH 1225 (4)
- MATH 1226 (4)

**Pathways 5A: Quantitative and Computational Thinking (3 hrs)**
- MATH 2214 (3)

**Pathways 6D: Critique and Practice in Design and Arts (6 hrs)**
- ENGE 1215/1216 (2/2)

**Pathways 6A: Critique and Practice in Design and Arts (3 hrs)**
- (3)

**Pathways 7: Critical Analysis of Identity and Equity in the United States**
- (3)

Pathways 7 can be double-counted with another core concept. In this case, additional free elective credits must be taken to maintain a minimum of 131 credits.

**Electives**
The Chip-Scale Integration Major requires 5 hours of free electives. Free electives only 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 Chip-Scale Integration Major requires 9 credits from a secondary focus area. All 9 credits must be from one ECE focus area from the attached list or from an approved individualized secondary focus plan. At least 3 credits must be at the 4xxx level.

**Change of Major Requirements:** For Change of Major requirement, please see: [http://www.enge.vt.edu/undergraduate-changing-majors.html](http://www.enge.vt.edu/undergraduate-changing-majors.html)

**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, ECE 2514, ECE 2544, MATH 2214, and PHYS 2306
- Upon completing 3 semesters in ECE, students must have satisfactorily completed ECE 2804.
- 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. (In determining the BSCPE and BSEE in-major GPA, all ECE courses, including repeats, are used).

**Grade Requirement:** Students must earn a C or higher in the following ECE courses: ECE 1004, ECE 2024, ECE 2214, ECE 2514, ECE 2544, ECE 2564, ECE 2714, ECE 2804.

**Statement of Prerequisites:** Pre-requisites for each course are listed after the course title. 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.

**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 Chip-Scale Integration in-major GPA, all ECE courses, including repeats, are used.
FOCUS AREAS WITHIN ECE

The courses listed below have been approved for the ECE focus areas. Students must choose 3 courses from a single focus area which DO NOT DUPLICATE major requirements. At least one course must be at the 4xxx level. 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.

CONTROLS, ROBOTICS, AND AUTONOMY

ECE3714 (3) INTRODUCTION TO CONTROL SYSTEMS, Pre: 2704 or (2714, 2804)
ECE4524 (4) ARTIFICIAL INTELLIGENCE AND ENGINEERING APPLICATIONS, Pre: (2574 or 3514), STAT 4714
ECE4580 (3) DIGITAL IMAGE PROCESSING
ECE4704 (3) PRINCIPLES OF ROBOTICS SYSTEMS, Pre: (2704 or (2714, 2804)) or (ME 3514, STAT 3704)

MACHINE LEARNING

ECE4424 (3) MACHING LEARNING (CS 4824), Pre: (2574 or 3514), (STAT 4604 or STAT 4705 or STAT 4714)
ECE4524 (4) ARTIFICIAL INTELLIGENCE AND ENGINEERING APPLICATIONS, Pre: (2574 or 3514), STAT 4714
ECE4525 (3) VIDEO GAME DESIGN AND ENG, Pre: 3574
ECE4526 (3) VIDEO GAME DESIGN AND ENG, Pre: 4525
ECE4554 (3) INTRODUCTION TO COMPUTER VISION, Pre: 3574, (STAT 4705 or STAT 4714)
ECE4580 (3) DIGITAL IMAGE PROCESSING

NETWORKING AND CYBERSECURITY

ECE4560 (3) COMPUTER AND NETWORK SECURITY FUNDAMENTALS, Pre: 2504 or (2544, 2804) or CS 3214
ECE4564 (3) NETWORK APPLICATION DESIGN, Pre: (2504 or (2544, 2804)), (2574 or 3514)
ECE4614 (3) TELECOMMUNICATION NETWORKS, Pre: ((2504, 2704) or (2544, 2714, 2804)), STAT 4714
CS4264 (3) PRINCIPLES OF COMPUTER SECURITY, Pre: CS 3214 or ((ECE 2500 or 3504), ECE 3574)

SOFTWARE SYSTEMS

ECE4524 (4) ARTIFICIAL INTELLIGENCE AND ENGINEERING APPLICATIONS, Pre: (2574 or 3514), STAT 4714
ECE4525 (3) VIDEO GAME DESIGN AND ENG, Pre: 3574
ECE4550 (3) REAL-TIME SYSTEMS, Pre: 3574 or CS 3214
ECE4574 (3) LARGE-SCALE SOFTWARE DEVELOPMENT FOR ENGINEERING SYSTEMS, Pre: 3574
CS3214 (3) COMPUTER SYSTEMS, Pre: (CS 2506, CS 2114) or (ECE 2564, ECE 3574)
COMMUNICATIONS AND NETWORKING

ECE3105 (3) ELECTROMAGNETIC FIELDS, Pre: 2004 or (2214, 2804), MATH 2204, PHYS 2306
ECE3614 (3) INTRODUCTION TO COMMUNICATION SYSTEMS, Pre: (2704 or (2714, 2804)), STAT 4714
ECE3704 (3) CONTINUOUS AND DISCRETE SYSTEMS, Pre: 2704 or (2714, 2804)
ECE4614 (3) TELECOMMUNICATION NETWORKS, Pre: ((2504, 2704) or (2544, 2714,2804)), STAT 4714
ECE4624 (3) DIGITAL SIGNAL PROCESSING AND FILTER DESIGN, Pre: 3704
ECE4634 (3) DIGITAL COMMUNICATIONS, Pre: 3614, STAT 4714
ECE4664 (1) ANALOG & DIGITAL COMM LAB, Pre: 3614; Co: 4634
ECE4684 (3) NETWORK SCIENCE, Pre: 2704 or (2714, 2804)

ENERGY AND POWER ELECTRONIC SYSTEMS

ECE3105 (3) ELECTROMAGNETIC FIELDS, Pre: 2004 or (2214, 2804), MATH 2204, PHYS 2306
ECE3204 (3) ANALOG ELECTRONICS, Pre: (2204, 2704) or (2214, 2714, 2804)
ECE3304 (3) INTRODUCTION TO POWER SYSTEMS, Pre: 3004
ECE3354 (1) POWER LAB, Co: 3304
ECE3704 (3) CONTINUOUS AND DISCRETE SYSTEMS, Pre: 2704 or (2714, 2804)
ECE4224 (3) POWER ELECTRONICS, Pre: 3204, 3304
ECE4284 (1) POWER ELECTRONICS LAB, Co: 4224
ECE4334 (3) POWER SYSTEM ANALYSIS AND CONTROL, Pre: 3304
ECE4354 (3) POWER SYSTEM PROTECTION, Pre: 4334
ECE4364 (3) ALTERNATE ENERGY SYSTEMS, Pre: STAT 4714
ECE4374 (1) POWER SYSTEM PROTECTION LAB, Pre: 4334; Co: 4354

MICRO/NANOSYSTEMS

ECE3105 (3) ELECTROMAGNETIC FIELDS, Pre: 2004 or (2214, 2804), MATH 2204, PHYS 2306
ECE3204 (3) ANALOG ELECTRONICS, Pre: (2204, 2704) or (2214, 2714, 2804)
ECE3274 (1) ELECTRONIC CIRCUITS LAB II, Pre: (2274 or 2804), 3074; Co: 3204
ECE3214 (3) SEMICONDUCTOR DEVICE FUNDAMENTALS, Pre: 2204 or (2214, 2804) or MSE 3204
ECE3614 (3) INTRODUCTION TO COMMUNICATION SYSTEMS, Pre: (2704 or (2714, 2804)), STAT 4714
ECE4205 (3) ELECTRONIC CIRCUIT DESIGN, Pre: 3204
ECE4220 (3) ANALOG INTEGRATED CIRCUIT DESIGN, Pre: 3204
ECE4234 (3) SEMICONDUCTOR PROCESSING, Pre: 2204 or (2214, 2804) or 3054
ECE4235 (3) PRINCIPLES OF ELECTRONIC PACKAGING, Pre: 2204 or (2214, 2804) or 3054
PHOTONICS
ECE3105 (3)  ELECTROMAGNETIC FIELDS, Pre: 2004 or (2214, 2804), MATH 2204, PHYS 2306
ECE3106 (3)  ELECTROMAGNETIC FIELDS, Pre: 3105
ECE3134 (3)  INTRODUCTION OPTOELECTRONICS, Pre: 2204 or (2214, 2804)
ECE3174 (1)  OPTOELECTRONICS LAB, Pre: 2274 or 2804; Co: 3134
ECE3614 (3)  INTRODUCTION TO COMMUNICATION SYSTEMS, Pre: 2704 or 2714, STAT 4714
ECE4134 (3)  PHOTONICS, Pre: 3106
ECE4144 (3)  OPTICAL SYSTEMS, Pre: 3105

RADIO FREQUENCY AND MICROWAVE
ECE3105 (3)  ELECTROMAGNETIC FIELDS, Pre: 2004 or (2214, 2804), MATH 2204, PHYS 2306
ECE3106 (3)  ELECTROMAGNETIC FIELDS, Pre: 3105
ECE3204 (3)  ANALOG ELECTRONICS, Pre: (2204, 2704) or (2214, 2714, 2804)
ECE3274 (1)  ELECTRONIC CIRCUITS LAB II, Pre: (2274 or 2804), 3074; Co: 3204
ECE3604 (3)  INTRODUCTION TO RF & MICROWAVE ENGINEERING, Pre: 3105
ECE4104 (3)  MICROWAVE AND RF ENGINEERING, Pre: 3106, 3204
ECE4114 (3)  ANTENNAS, Pre: 3106
ECE4124 (3)  RADIO WAVE PROPAGATION, Pre: 3106
ECE4220 (3)  ANALOG INTEGRATED CIRCUIT DESIGN, Pre: 3204
ECE4605 (3)  RADIO ENGINEERING, Pre: 3105, 3204, 3614

SPACE SYSTEMS
ECE3105 (3)  ELECTROMAGNETIC FIELDS, Pre: 2004 or (2214, 2804), MATH 2204, PHYS 2306
ECE3106 (3)  ELECTROMAGNETIC FIELDS, Pre: 3105
ECE3104 (3)  INTRO SPACE SYSTEMS, Pre: 3105
ECE3154 (2)  SPACE SYSTEMS – DESIGN, Pre: 3105; Co: 3104
ECE3614 (3)  INTRODUCTION TO COMMUNICATION SYSTEMS, Pre: (2704 or (2714, 2804)), STAT 4714
ECE4154 (3)  INTRODUCTION TO SPACE WEATHER, Pre: 3106
ECE4164 (4)  INTRODUCTION TO FLOBAL POSITIONING SYSTEMS (GPS) THEORY AND DESIGN, Pre: 3106 or AOE 4134
ECE4194 (3)  ENGINEERING PRINCIPLES OF REMOTE SENSING, Pre: 3106
ECE4644 (4)  SATELLITE COMMUNICATIONS, Pre: 3614
INDEPENDENT STUDIES AND UNDERGRADUATE RESEARCH

ECE 4974 Independent Study and ECE 4994 Undergraduate Research listed below can *generally* be used as part of the Secondary Focus Area if the topic of the course fits with student’s stated career goals and the student has a faculty for supervising the course. Please discuss Secondary Focus Area options for ECE 4974/ECE 4994 with your advisor prior to completing the required paperwork to add these courses. For purposes of satisfying the Secondary Focus requirements, the sum of the number of hours taken from ECE 4974 and 4994 cannot exceed 6 credits.

4974  (ARR)  Independent Study
4994  (ARR)  Undergraduate Research

Students must complete the College of Engineering Undergraduate Research/Independent Study Form, the ECE Undergraduate Research/Independent Study Secondary Focus Proposal Form, and the ABET Breakdown prior to registration. To be considered for inclusion in the Secondary Focus, all forms are due to the ECE Student Services office no later than 2 weeks before classes begin for the requested semester – no exceptions. Forms are available online at [www.ece.vt.edu/undergrad/policies](http://www.ece.vt.edu/undergrad/policies).

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.