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Undergraduate Students Handbook
in
Electrical and Computer Engineering
(Classes of 2022+)

This handbook can be found at
the ECE website

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Handbook for Undergraduate Students (2023+)

This handbook describes the details of the undergraduate program offered by the Department of Electrical and Computer Engineering. Each student is responsible for every aspect of completing his/her degree requirements. All relevant information is contained in the attachments. Be sure to thoroughly read this handbook, paying attention to all of the degree requirements. Before registering for any course, a student must have met the necessary prerequisites. Also, prior approval is required for any courses a student wishes to take at another institution if those courses are intended to fulfill degree requirements. Please note that additional advising material is available at SOE Dean's website http://soe.rutgers.edu/oaa**.**

The undergraduate program consists of two specific options: (1) Electrical Engineering (EE) option and (2) Computer Engineering (CE) option. **Both options lead to the same B.S. Degree in Electrical and Computer Engineering (ECE).** Details of the two curricula are provided shortly. It should be noted that the freshman and sophomore years are common to both options. In either option, a student takes several elective courses in addition to the required courses. There are several categories of elective courses, including (1) Technically oriented electives, (2) Science Math and Engineering elective, (3) Humanities/Social Science electives and (4) General electives.

Please note that there have been some minor changes in the curricula for students graduating in 2023 and beyond, when compared to previous years. In particular,

- The Linear Systems and Signals Lab is no longer part of the curricula. Instead, students must now complete the 1-credit class 14:332:449 Intro to Capstone Design during the appropriate (typically Fall) semester.
- The 14:332:254 Programming Methodology I (PM1) Lab has been discontinued. Instead, the PM1 Lab has been incorporated into an upgraded 4 credit 14:332:252 PM1 course.

Additionally, both EE and CE options now require a total of 123 credits, with a residency requirement of 51 credits. The EE option now includes a “Restricted Electrical Elective” that requires students to choose one class from a set of three computer engineering classes. The CE option has seen several changes, including no longer requiring courses in Electronic Devices and Digital Electronics; a “Restricted Computer Elective” that requires students to choose one class from a set of three electrical engineering classes.

1. Degree Title

Bachelor of Science (BS) in Electrical and Computer Engineering (BSECE)

1.1 Electrical and Computer Engineering Mission Statement

The mission of the ECE undergraduate program is to provide students with a broad and flexible education in electrical and computer engineering that prepares its graduates for rapidly changing technological fields with a sound basis for professional practice, advanced education, active citizenship, and lifelong learning. The students are prepared to expand this knowledge through research into new technologies, design methods, and analysis techniques that link the knowledge with multi-disciplinary fields and advance the state of the art. With a knowledge of contemporary technological issues and their impact globally, economically, and environmentally, electrical and computer engineers are at the forefront of advances that continually transform society.

1.2 Degree Requirements

A B.S. Degree in Electrical and Computer Engineering has the following requirements:

Required Number of Degree Credits:

The Electrical Engineering (EE) and Computer Engineering (CE) options each require 123 credits for graduation. Under certain circumstances, due to one reason or another, a student might be exempted from taking a required course. If so, to satisfy the number of degree credits required, the student needs to take an additional elective course in its place. Consult with the Undergraduate Director for guidance.

ECE Residency requirement: to satisfy the requirements for graduation, a minimum number of 14:332:xxx credits must be taken. Students majoring in either the Electrical Engineering **or** the Computer Engineering option need to take **51 credits in 14:332:xxx courses**.

Required Number of Electives for the ECE major:

Electives consists of: **two** (2) courses of Technical electives, **one** (1) course of Science Math Engineering elective, **two** (2) lower level Hum/Soc electives, **two** (2) upper level Hum/Soc electives, **one** (1) General elective, **and either**

- *Electrical Engineering Option:* **three** (3) courses of Electrical electives, **one** (1) course of Restricted Electrical elective,
- *Computer Engineering Option:* **three** (3) courses of Computer electives, **one** (1) course of Restricted Computer elective.

Note that fall SOE students must take 18 credits of humanities/social science requirements, including 12 credits of electives, specifically, **two** courses of lower level Hum/Soc electives and **two** courses of upper level Hum/Soc electives. In addition, all SOE students must take Engineering Economics (14:540:343). For more info on humanity electives, see http://soe.rutgers.edu/oaa/electives.

General Info	**Electrical Engineering Option** **Total credits = 123** Residency requirements: 51 credits	**Computer Engineering Option** **Total credits = 123** Residency requirements: 51 credits
Shared CORE Courses	PEE 1 + Lab; PEE 2 + Lab; DLD + Lab; Programing Method. 1; Probability; Discrete Math; Linear Signals and Systems; Computer Architecture + Lab; Ethics; Capstone	
Option Specific CORE courses	Digital Signal Processing + Lab (332:346+348) Electronic Devices + Lab (332:361+363) Digital Electronics + Lab (332:366+368) **OVERALL: 12 credits**	Programing Method. 2 (332:351) Software Engineering (332:452); Intro to Computer Sys. (332:434) Digital System Design (DSD) (332:437) **OVERALL: 12 credits**
Electrical /Computer Electives	EE: Choice of 3 **(three) Electrical** Electives, and **1 (one) restricted electrical elective** or CE: Choice of 3 **(three) Computer** Electives, and **1 (one) restricted computer elective**	
	Choice of **ONE** of three *restricted* electrical elective: Programing Method 2 (332:351) Intro to Info. and Network Security (332:424) Computer and Comm. Networks (332:423)	Choice of **ONE** of three *restricted* computer elective: Electronic Devices (332:361) Digital Signal Proc. (332:346) Princ. Communication Systems (332:322)
Tech Electives	Choice of **2 (two) Technical** Electives	
Other electives	**1 Science, math, engineering** elective **1 general** elective **2 lower level Hum/Soc** electives, and **2 upper level Hum/Soc** electives	
Economics	**1 course** in Engineering Economics (14:540:343)	

1.3 Program Educational Objectives

Consistent with the stated mission of the University, the *mission* of the electrical and computer engineering program is to prepare its graduates for a rapidly changing technological field. The current educational objectives of the Electrical and Computer engineering program are that within 3-5 years:

- Expectation: graduates will exceed the expectations of employers of electrical and computer engineers;
- Advanced Study: qualified graduates will pursue advanced study if they so desire; and
- Leadership: graduates will pursue leadership positions in their profession and/or communities.

1.4 Student Outcomes

Rutgers ECE graduates should have attained:

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

1.5 The Relationship Between Educational Objectives and Outcomes

Relationship of student learning outcomes to program educational objectives. The outcomes and objectives are noted by abbreviated descriptions.

Outcome	Objective 1 Expectations	Objective 2 Advance Study	Objective 3 Leadership
(1) Math/Science Engineering/Solve Problems	•	•	
(2) Design	•	•	
(3) Communication	•		•
(4) Ethics	•	•	•
(5) Team and Project Management	•		•
(6) Experiments/Data Analysis	•	•	
(7) Lifelong Learning	•	•	•

Relationship between student outcomes (SOs) addressed in each required course in the Electrical and Computer Engineering curricula. The level of support is marked by H (highly supported) or S (supported).

Course Name and Number	1	2	3	4	5	6	7
221 Principles of Electrical Engineering I	H						S
222 Principles of Electrical Engineering II	H		S			S	S
223 Principles of Electrical Engineering I Laboratory	H	S	H	S	H	H	S
224 Principles of Electrical Engineering II Laboratory	H	S	H	S	H	H	S
226 Probability and Random Processes	H	H	S			S	S
231 Digital Logic Design	H	S	S	S		H	S
233 Digital Logic Design Laboratory	H	H	H	S	H	H	S
252 Programming. Methodology I	H		S				S
312 Discrete Mathematics	H		S	S			
331 Computer Architecture and Assembly Language	H		S			S	S
333 Comp. Architecture Laboratory	H		S		S	H	S
345 Linear Systems and Signals	H	S	H				S
346 Digital Signal Processing	H	S	H				S
348 Digital Signal Processing Laboratory	H	S	S			S	S
351 Programming Methodology II	H		S				S
361 Electronic Devices	H		S			S	S
363 Electronic Devices Laboratory	H	S	H	S	S	H	S
366 Digital Electronics	H		S			S	S
368 Digital Electronics Lab	H	S	H	S	S	H	S
393 Professionalism/Ethics				H			S
434 Introduction to Computer Systems	H						S
437 Digital Systems Design	H		S			S	S
449 Intro to Capstone	S	S	S	S	S		S
448 Capstone Design in ECE	H	H	H	H	H	H	H
452 Software Engineering	H	H	H	S	H	H	S

2. Combined Degree Options, Minors and Double Majors

2.1 BS/MS programs (http://soe.rutgers.edu/oas/BS-Masters):

Please refer to the ECE Graduate Handbook for more information

https://www.ece.rutgers.edu/undergraduate-and-graduate-student-handbooks

2.2 Minors, Double Majors, and Dual Degree (http://soe.rutgers.edu/oas/minors-majors):

Minors, double majors, and dual degrees provide students with the opportunity to broaden skill sets outside of engineering. Often you can choose your courses so that they can be 'double-counted' – meaning that the courses will count towards your minor (or major, or dual degree), and count towards engineering. Many of the technical minors (math, computer science, life sciences, etc.) can often count for both the minor and as part of the technical electives for the engineering major. Many of the humanities/social science minors (history, psychology, language, economics, etc.) can count for the minor and as the humanities requirements.

2.3 Minoring in CS:

Requirements for minoring in Computer Science (CS) may be found on the CS Department site at https://www.cs.rutgers.edu/undergraduate/minor-computer-science.

A CS minor currently requires 198:111, 198:112 and four additional CS courses; details can be found at cs.rutgers.edu. A CS minor is facilitated by the equivalences: PM1 (332:252) and CS 111 (198:111); and PM2 (332:351) and CS 112 (198:112).

A suggested choice enabling a CS minor is as follows: Take 198:111, 112, 213/214, and **three** CS electives as Tech electives and either Computer electives or Electrical electives. These electives are to be taken among the courses listed as technical electives. Substitute 198:111 and 198:112 for ECE courses 332:252, and 332:351 (PM I and PM II). You may also take a CS course as a Science Math Engineering elective.

Keep in mind:

- The CS minor is easier under the CE option because 198:112 replaces PM2, which is required for the CE option.
- Taking courses required for the CS minor can make the ECE residency requirement more challenging.
- **Students should check with a CS departmental advisor before finalizing their schedules.**

Note that with any substitution of an ECE course: Electrical Engineering option students need to take 51 credits of 14:332:xxx and Computer Engineering option students need to take 51 credits of 14:332:xxx.

2.4 Double Majoring in Computer Science and Computer Engineering:

Consult CS Website for details. ECE requirements are the same whether you are a double degree major or a single degree major. You must check with CS department or their website to know what is required to get a BS in CS. You could use some CS courses as electives for ECE. You have to look at the elective list for the computer option to find out what CS courses can be used as electives for ECE. Also, look at the info under `Equivalent of Courses' as given above.

Note that with any substitution of an ECE course: both EE option and CE option students need to take 51 credits of 14:332:xxx courses. For the CS major, the CS department has a similar residency requirement in 01:198:xxx courses. To double major in ECE and CS, a student must meet the residency requirements of both departments. This double residency requirement is often the most difficult hurdle in achieving the ECE/CS double major.

Differences between Computer Science and Computer Engineering:

Computer science (CS) and computer engineering (CE) are related to each other but different in their emphasis. When you think of a COMPUTER, two aspects of it are prominent, software (Programming, programming languages, data structures, etc.) and hardware (architecture and what goes in building it, the circuitry). CS deals with mostly software and hardware is only tangential. On the other hand, CE is the other way.

Let us take an analogy, say the automobile. To make use of an automobile, one really does not need to know how it works. All that needs is the knowledge of how to drive it and familiarity with some warning signs for service and repair. However, knowing something about how an automobile works will enhance the use of it. On the other hand, an engineer designing an automobile must deal with its architecture both functionally as well as appearance wise. This involves physical hardware design and construction.

Now let us take the computer instead of an automobile. Computer Science (CS) is mainly interested in using the computer as a tool just like a driver is interested in using an automobile. Thus, the curriculum in CS concentrates on the languages needed to communicate with a computer. In other words, software is emphasized although computer architecture and other aspects of hardware are briefly reviewed.

Computer Engineering (CE) emphasizes the architecture, and the physical design of circuitry to make it work. However, some aspects of software are also discussed but not to the same extent as Computer Science does.

2.5 Minor In Data Science

The Data Science Minor is designed to equip students to become proficient in the principles of computation, statistical inference, and data management and their applications in a specific domain/field. Students are required to complete six courses and a mini capstone. Students must maintain a GPA of 2.0 in the courses applied to the minor. No courses with a D can be counted toward the minor.

The Requirements for minoring in Data Science (DS), including the list of courses that must be completed, and domain courses may be found at:

https://mps.rutgers.edu/data-science-program/data-science-program-minor

2.6 BS-MS Program:

Please refer to the ECE Graduate Handbook for more information
https://www.ece.rutgers.edu/undergraduate-and-graduate-student-handbooks

3 ECE Program Information

The following tables detail a typical sequence for the core and elective courses requirements for the electrical engineering and computer engineering options:

3.1 Electrical Engineering Curriculum: (Class of 2023+)

Freshman Year							
01:160:159	General Chemistry for Engineers		3	14:440:127	Intro to Computers for Engineers		3
01:160:171	Introduction to Experimentation		1	14:440:221	Engineering Mechanics		3
01:355:101	Expository Writing		3	01:640:152	Calculus II		4
14:440:100	Engineering Orientation		1	01:750:124	Analytical Physics IB		2
01:640:151	Calculus I Math/Physics		4	__:___:___	Hum/Soc elective		3
01:750:123	Analytical Physics IA		2				
__:___:___	Hum/Soc elective		3				
Total Credits			**17**	**Total Credits**			**15**
Sophomore Year							
14:332:221	Principles of Elec. Eng. I	M	3	14:332:222	Principles of Elec. Eng. II	M	3
14:332:223	Principles of EE I Lab	M	1	14:332:224	Principles of EE II Lab	M	1
14:332:231	Digital Logic Design	M	3	14:332:226	Probability & Random Proc.	M	3
14:332:233	Digital Logic Design Lab	M	1	14:332:252	Programming Method. I	M	4
01:640:251	Multivariable Calculus		4	01:640:244	Differential Equations		4
01:750:227	Analytical Physics IIA		3				
01:750:229	Analytical Physics II Lab		1				
Total Credits			**16**	**Total Credits**			**15**
Junior Year							
14:332:331	Computer Arch.	M	3	14:332:312	Discrete Mathematics*	M	3
14:332:333	Computer Arch. Lab	M	1	14:332:346	Digital Signal Processing	M	3
14:332:345	Linear Systems & Signals	M	3	14:332:348	Digital Signal Proc. Lab	M	1
14:332:361	Electronic Devices	M	3	14:332:393	Professionalism/Ethics	M	1
14:332:363	Electronic Devices Lab	M	1	14:332:366	Digital Electronics	M	3
__:___:___	Hum/Soc elective (200+)		3	14:332:368	Digital Electronics Lab	M	1
14:332:___	Restricted Electrical elective	M	3	14:540:343	Engineering Econ	M	3
Total Credits			**17**	**Total Credits**			**15**
Senior Year							
14:332:449	Intro to Capstone Design	M	1	14:332:448	Capstone Design in ECE	M	3
14:332:___	Electrical elective	M	3	14:332:___	Electrical elective	M	3
14:332:___	Electrical elective	M	3	__:___:___	Technical elective	M	3
__:___:___	Technical elective	M	3	__:___:___	General elective		3
__:___:___	Hum/Soc elective (200+)		3				
__:___:___	Science Math Eng elective	M	3				
Total Credits			**16**	**Total Credits**			**12**
Total degree credits: 123							

3.2 Computer Engineering Curriculum: (Class of 2023+)

Freshman Year							
01:160:159	General Chemistry for Engineers		3	14:440:127	Intro to Computers for Engineers		3
01:160:171	Introduction to Experimentation		1	14:440:221	Engineering Mechanics		3
01:355:101	Expository Writing		3	01:640:152	Calculus II		4
14:440:100	Engineering Orientation		1	01:750:124	Analytical Physics IB		2
01:640:151	Calculus I Math/Physics		4	__:___:___	Hum/Soc elective		3
01:750:123	Analytical Physics IA		2				
__:___:___	Hum/Soc elective		3				
Total Credits			**17**	**Total Credits**			**15**
Sophomore Year							
14:332:221	Principles of Elec. Eng. I	M	3	14:332:222	Principles of Elec. Eng. II	M	3
14:332:223	Principles of EE I Lab	M	1	14:332:224	Principles of EE II Lab	M	1
14:332:231	Digital Logic Design	M	3	14:332:226	Probability & Random Proc.	M	3
14:332:233	Digital Logic Design Lab	M	1	14:332:252	Programming Method. I	M	4
01:640:251	Multivariable Calculus		4	01:640:244	Differential Equations		4
01:750:227	Analytical Physics IIA		3				
01:750:229	Analytical Physics II Lab		1				
Total Credits			**16**	**Total Credits**			**15**
Junior Year							
14:332:331	Computer Arch.	M	3	14:332:312	Discrete Mathematics*	M	3
14:332:333	Computer Arch. Lab	M	1	14:332:452	Software Engineering	M	3
14:332:345	Linear Systems & Signals	M	3	14:332:434	Intro to Comp. Systems	M	3
14:332:351	Programming Method. II	M	3	14:332:393	Professionalism/Ethics	M	1
14:332:___	Restricted Comp. elective	M	3	14:540:343	Engineering Econ	M	3
__:___:___	Hum/Soc elective (200+)	M	3	__:___:___	Technical elective	M	3
Total Credits			**16**	**Total Credits**			**16**
Senior Year							
14:332:437	Digital System Design	M	3	14:332:448	Capstone Design in ECE	M	3
14:332:449	Intro to Capstone Design	M	1	__:___:___	Computer elective	M	3
__:___:___	Computer elective	M	3	__:___:___	Technical elective	M	3
__:___:___	Computer elective	M	3	__:___:___	General elective		3
__:___:___	Hum/Soc elective (200+)		3				
__:___:___	Science Math Eng elective	M	3				
Total Credits			**16**	**Total Credits**			**12**
Total degree credits: 123							

* Note that 14:332:312 Discrete Mathematics is listed in the Spring semester of a student's Junior year. This is where Discrete Mathematics has historically been placed in the sequence. However, recent changes to the pre-requisites for Discrete Mathematics allow students to take this class as early as the Fall of their Sophomore year.

Electives consists of: two (2) course of technical elective, one (1) course of Science Math and Engineering elective, two (2) lower level Hum/Soc electives, one (1) general elective, two (2) upper level Hum/Soc electives, **and**

- **EE option**: three (3) courses of electrical electives, and one (1) course of restricted electrical elective, or,
- **CE option**: three (3) courses of computer electives, and one (1) course of restricted computer elective.

For more info on humanity electives, see http://soe.rutgers.edu/oaa/electives.

For more info on topics courses, see **https://www.ece.rutgers.edu/undergraduate-course-descriptions**

Residency requirement is 51 credits. All credits earned in 14:332:xxx courses count toward residency.

Many ECE courses are offered only once a year in the indicated semesters, although some of the larger, core classes in both the fall and spring semester or in the summer. Traditionally, odd numbered ECE courses were offered in the Fall and even numbered in the Spring. Consequently, exceptions to this pattern have arisen and will continue to occur, e.g. 466 and 472 are offered in Fall, and 312 is being offered in both the Fall and Spring. The order of the electives as indicated in bold is just a suggestion. They can be reordered as necessary.

Beware that a viable capstone design project is a requirement, and that all students must take the two course Capstone sequence (449 and 448) in the final two semesters. Most students will graduate in the Spring by taking 449 in the preceding Fall semester and 448 in the final Spring semester. However, those students on schedule to graduate in the Fall can contact the Undergraduate Director to request taking 449 in the preceding Spring and 448 in the Fall.

Independent study courses 14:332:491 and 14:332:492: up to six credits are acceptable. These credits can count for either electrical/computer electives or as technical electives.

The Internship course 14:332:495, and Co-Op Internship courses 14:332:496 and 14:332:497: up to six (6) credits are acceptable. These courses count as **technical electives only**.

A maximum of nine (9) credits is acceptable with 14:332:491, 14:332:492, 14:332:496 and 14:332:497 courses.

3.3 General guidelines on electives:

3.3.1 **Science Math and Engineering Elective:** any 3 Cr or 4 Cr course at 200 level or higher in any area of Science, or Mathematics, or Engineering. Although students are free to select this elective, they are encouraged to take a course that will later serve as a prerequisite for more advanced courses that would be of interest. There are several required courses in Math and Science. Any course lower level to the required courses is not allowed as a Science Math and Engineering Elective. Also, if a course qualifies as a Humanities course, it is not allowed as a Science Math and Engineering Elective. A list of electives is given later.

3.3.2 **Independent Study/Special Problems option:** The Department of Electrical and Computer Engineering allows a student to earn six academic credits for research through the Independent Study/Special Problems courses 14:332:491 and 14:332:492. Credits can count as either electrical/computer electives or technical electives, provided permission has been granted by a faculty supervisor and the Undergraduate Director. **Note that Independent Study/Special Problems courses are not open to students on academic probation.** A maximum of 3 credits of

Independent Study/Special Problems may be taken in any one semester. **Independent Study/Special Problems xxx:491 and xxx:492**, where "xxx" is a departmental code other than 332, are not considered as electives unless they have been approved **prior to the start of classes by the Undergraduate Director**. Again, a maximum of 6 such credits may be counted toward the B.S. degree and a maximum of 3 credits may be taken in any one semester.

A one-page proposal of the technical work along with its title and an application form (found on ECE website) properly filled must be submitted to the Undergraduate Director to enroll in this course. Students who are on academic probation are not qualified to enroll in this course.

A technical report and poster describing in detail the study undertaken must be submitted at the end of the study. Students enrolled in 491 or 492 will be enrolled in a canvas course for the collection of these deliverables.

3.3.3 **Co-Op/Internship option**: The Department of Electrical and Computer Engineering allows a student to earn six academic credits on a Pass/No credit basis. These credits may come from Co-Op and Internship courses.

Upon successful completion, six credits of ECE Internship or ECE Co-Op Internship courses can be used as a **technical elective**.

Students who plan to enroll in the ECE Internship (14:332:495) or the ECE Co-Op Internship (14:332:496/497) courses should review the guidelines specified under the course heading 14:332:496/497 Co-Op Internship in Electrical and Computer Engineering on the department's webpage. The student should contact the Career Services Center at Rutgers to review listings of participating organizations/companies for possible interest. Contact the Co-Op Student Services Administrator, Career Services-Employment Center, Busch Campus Center.
Eligible student should not be on academic probation and have completed a minimum of 90 credits (40 credits in the major) with a cumulative grade point average of 2.5 or better.

The 3-credit internship class 14:332:495 is available for students who are working part-time and have an employment in a field closely related to electrical and computer engineering. Specifically, for the 3-credit internship course, students must be employed for a duration of at least 10 weeks, for a total of 180 hours of work.

Co-op must at least be of six months of continuous duration, full time for six credits or at least three months for three credits. Normally, it is to be taken in the summer/fall semesters or spring/summer semesters. The Internship should continue with the same employer during both semesters. A three months Co-Op during either fall or spring semester will count towards three credit technical elective. The Co-Op credit will not be given for summer employment alone.

To enroll in either the Internship or Co-Op courses, the student must apply by submitting an SPN (Special Permission Number) request webform on the ECE website during the course enrollment period. This webform asks for a short description of the project or position, including the project supervisor and/or employer. This application is reviewed by the Undergraduate Director before the SPN is issued. Because a Co-Op is fulltime position for an extended 6 month duration, Co-Op students need to get the approval of the Undergraduate Director **prior to the employment**. On the other hand, for the 495 Internship, students may choose to begin a summer internship and (in mid-summer) apply (by submitting the SPN request on the website) to enroll in the 495 Internship course in the following fall semester. Students who plan to complete an internship in the spring semester can request to earn credit in the same spring semester that the internship is

taking place only. Students who complete an internship in the summer, can either earn credit in the summer completing the internship or the following fall semester. Students completing an internship in the fall semester can only earn credit in the fall semester when they are completing the internship.

Note that international students in the ECE program will need to sign up for Curricular Practical Training (CPT) in order to complete an internship. In this case, the 495 Internship course will need to be taken concurrent with the internship; see
https://soe.rutgers.edu/oas/coop#cpt
for additional details

Students enrolled in the 495 Internship or the 496/497 Co-Op courses will be enrolled in a canvas course for the collection of deliverables that verify the completion of the Co-Op or Internship. The required deliverables include various intermediate reports, questionnaires, an employer survey, and a final report and project poster that overview the work performed. Other requirements may be added to the canvas course if necessary.

A maximum of nine (9) credits are acceptable with 14:332:491, 14:332:492, 14:332:495, 14:332:496 and 14:332:497 courses.

Please note that Rutgers does offer another option for internship and Co-Ops that provides general elective credit. More information can be found at:
https://careers.rutgers.edu/students-alumni/develop-your-skills/academic-courses/rutgers-internship-co-op-program-ricp
This option is intended for non-technical internships. For internships with an appropriate ECE technical focus, the ECE technical elective and residency credits make 14:332:495 Internship credit a better choice.

3.3.4 **Humanities/Social Science Requirements:** all SOE majors must take a total of 18 credits of humanities/social science courses. For a description and list of acceptable humanities/social science requirements, please refer to the website: http://soe.rutgers.edu/oas/electives.

The courses **01:355:101** Expository Writing and **01:220:102** Introduction to Microeconomics are required courses that are a part of the humanities/social science requirements.

Additional advising information is available at http://soe.rutgers.edu/oas.

The course **14:332:301 Wireless Revolution** counts as an upper level Hum/Soc elective for SOE majors. It is neither a department elective, nor a technical elective, nor MSE elective. However, 14:332:301 Wireless Revolution does count toward the ECE residency requirement.

3.3.5 **General Electives:** Almost any course taught for credit at Rutgers qualifies as a general elective, including technically oriented electives and humanities/social science electives. There are, however, a few exceptions. Such exceptions include remedial courses and courses related to athletics and sports. For more information, see http://soe.rutgers.edu/oas/electives. Although students are free to select this elective, they are encouraged to take an ECE course that will later serve as a prerequisite for more advanced ECE courses that would be of interest.

3.4 List of Electives for the Electrical Engineering Option

Guideline for electives selection for Electrical Engineering option:

3.3.1 FOUR Electrical Electives are to be selected from list 3.4.1.

3.3.2 Any TWO Technical Electives are to be selected from list 3.4.2.

3.3.3 One Science Math and Engineering elective (any Science, Math, or Engineering course above 200 level)

3.3.4 One general elective

3.3.5 Each 4-credit Computer Science (Livingston College) course constitutes one elective course.

3.3.6 Students with a cumulative average of 3.2 or better may take a graduate level course as a Technical or Electrical Elective with the approval of their advisor, instructor of the course, and the Dean's office.

LIST 3.4.1: ELECTRICAL ELECTIVES

14:332:322	Principles of Communication Systems
14:332:351	Programming Methodology II (The course 198:112 can be taken in place of 332:351)
14:332:376	Virtual Reality (14:332:378 is a corequisite)
14:332:382	Electromagnetic Fields
14:332:402	Sustainable Energy: Choosing among options
14:332:411	Electrical Energy Conversion
14:332:415	Introduction to Automatic Control Theory (has not been offered since 2007, contact UG director)
14:332:417	Introduction to Control System Design
14:332:421	Wireless Communication Systems
14:332:423	Computer and Communication Networks
14:332:424	Introduction to Information and Network Security
14:332:427	Communication System Design
14:332:434	Introduction to Computer Systems
14:332:435	Topics in Electrical and Computer Engineering
14:332:436	Topics in Electrical and Computer Engineering
14:332:437	Digital System Design
14:332:443	Machine Learning for Engineers
14:332:445	Topics in Electrical and Computer Engineering
14:332:446	Topics in Electrical and Computer Engineering
14:332:447	Digital Signal Processing Design
14:332:451	Introduction to Parallel and Distributed Programming
14:332:452	Software Engineering
14:332:453	Mobile App Engineering and User Experience
14:332:456	Network-Centric Programming (Usually offered only in alternate years)
14:332:460	Power Electronics
14:332:463	Analog Electronics
14:332:464	RF Integrated Circuits
14:332:465	Physical Electronics
14:332:466	Opto-Electronic Devices
14:332:467	Microelectronic Processing
14:332:472	Robotics and Computer Vision
14:332:474	Introduction to Computer Graphics (The course 198:428 can be taken in place)
14:332:479	VLSI Design
14:332:481	Electromagnetic Waves
14:332:482	Deep Submicron VLSI Design for Electrical and Computer Engineering
14:332:493	Topics in Electrical and Computer Engineering
14:332:494	Topics in Electrical and Computer Engineering

14:332:491/2 Special Problems/Independent Study (not open to students on academic probation)

For more info on topics courses, see **https://www.ece.rutgers.edu/undergraduate-course-descriptions**

LIST 3.4.2: TECHNICAL ELECTIVES

14:xxx: (where "xxx" is a departmental code): SOE 200+ level courses from other departments are accepted as technical electives;

14:332:491/2 Special Problems/Independent Study (not open to students on academic probation)
14:332:495 Internship in Electrical and Computer Engineering
14:332:496/7 Co-Op and Internship (not open to students on academic probation)

11:117:413 Unit Processes in Environmental Engineering I
11:117:414 Unit Processes in Bioenvironmental Engineering II
11:117:462 Design of Solid Waste Treatment Systems
11:117:474 Air Pollution Engineering

14:125:201 Introduction to Biomedical Engineering
14:125:208 Introduction to Biomechanics
14:125:255 Biomedical Engineering System Physiology

14:155:201 Chemical Engineering Material and Energy Balances
14:155:208 Chemical Engineering Thermodynamics I

14:180:216 Introductory Computer-Aided Design and Drafting
14:180:243 Mechanics of Solids

01:198:213 Software Methodology
01:198:214 Systems Programming
01:198:314 Principles of Programming Languages
01:198:323* Numerical Analysis and Computing
01:198:334 Introduction to Imaging and Multimedia
01:198:336 Principles of Information and Data Management
01:198:344 Design and Analysis of Computer Algorithms
01:198:417 Distributed Systems: Concepts and Design
01:198:424 Modeling and Simulation of Continuous Systems
01:198:440 Introduction to Artificial Intelligence
01:198:442 Topics in Computer Science
14:332:443 Machine Learning for Engineers
01:198:445 Topics in Computer Science
01:198:444 Topics in Computer Science
01:198:445 Topics in Computer Science
01:198:452 Formal Languages and Automata

07:211:330 Animation 3D

14:440:222 Engineering Mechanics: Dynamics
14:440:301 Introduction to Packaging Engineering
14:440:302 CAD for Packaging Engineering

14:440:371	Packaging Evaluation Methods
14:440:373	Packaging Manufacturing
14:440:378	Sustainable Packaging
14:440:392	Undergraduate Research in Engineering
14:440:403	Safety Engineering in Packaging
14:440:406	Packaging Printing and Decoration
14:440:468	Packaging Machinery
14:440:471	Distribution Packaging
14:540:201	Work Design and Ergonomics
14:540:320	Engineering Statistics
14:540:491	Special Problems
14:635:203	Introduction to Materials Science & Engineering (NB)
14:635:204	Materials Processing
14:635:205	Crystal Chemistry and Structure of Materials
14:635:206	Thermodynamics of Materials
14:635:212	Physics of Materials
14:635:303	Phase Diagrams
14:635:304	Ceramic Compositions
14:635:305	Materials Microprocessing
14:635:306	Processing III
14:635:307	Kinetics of Materials Processes
14:635:309	Characterization of Materials
14:635:312	Glass Engineering
14:635:314	Strength of Materials
14:635:316	Electronic, Optical and Magnetic Properties of materials
14:635:320	Introduction to Nanomaterials
14:635:321	Structural, Mechanical and Chemical Application of Nanostructures and Nanomaterials
14:365:322	Photonic, Electronic and Magnetic Applications of Nanostructures and Nanomaterials
14:635:330	Introduction to Nanomaterials
14:635:340	Electrochemical Materials and Devices
14:635:405	Solar Cell design and Processing
14:650:210	Introduction to Aerospace Engineering
14:650:231	Mechanical Engineering Computational Analysis and Design
14:650:291	Mechanics of Materials
14:650:312	Fluid Mechanics
14:650:342	Design of Mechanical Components
14:650:350	Mechanical Engineering Measurements
14:650:351	Thermodynamics
14:650:388	Computer-Aided Design in Mechanical Engineering
01:640:250	Introductory Linear Algebra
01:640:311	Introduction to Real Analysis I
01:640:312	Introduction to Real Analysis II
01:640:350	Linear Algebra
01:640:351	Introduction to Abstract Algebra I
01:640:352	Introduction to Abstract Algebra II
01:640:354	Linear Optimization
01:640:357	Topics in Applied Algebra
01:640:373*	Numerical Analysis I

01:640:374* Numerical Analysis II
01:640:403 Introduction to Theory of Functions of a Complex Variable
01:640:423 Elementary Partial Differential Equations (01:640:421 is not acceptable)
01:640:424 Stochastic Models in Operations Research
01:640:428 Graph Theory

01:640:454 Combinatorics
01:640:478 Introduction to Stochastic Processes

01:750:228 Analytical Physics IIB
01:750:273 Honors Physics III
01:750:313 Modern Physics
01:750:351** Thermal Physics
01:750:406 Introductory Solid State Physics
01:750:417 Intermediate Quantum Mechanics
01:750:421 Fluid and Plasma Phenomena
01:750:464 Mathematical Physics

01:960:463 Regression Methods
01:960:467 Applied Multivariate Analysis
01:960:484 Basic Applied Statistics

01:160:307 Organic Chemistry I
01:160:308 Organic Chemistry II
01:160:315 Honors Organic Chemistry I
01:160:316 Honors Organic Chemistry II

Independent Study or Special Problems xxx:491, xxx:492, other than 332, are not, in general, considered as electives.

NOTEs:
* Credit not given for both 01:198:323-324 and 01:640:373-374
** Credit not given for both 01:750:351 and 14:650:351
***** Credit will not be given to 01:198:416**

3.5 List of Electives for the Computer Engineering Option

Guideline for electives selection for Computer Engineering option:

3.4.1 TWO Computer Electives are to be selected from list 3.5.1.
3.4.2 Any One Elective is to be selected from either list 3.5.1 or list 3.5.2.
3.4.3 Any One Elective is to be selected from list 3.5.2.
3.4.4 One Science Math and Engineering elective (any Science, Math, or Engineering course above 200 level)
3.4.5 Each 4-credit Computer Science (Livingston College) course constitutes one elective course.
3.4.6 Students with a cumulative average of 3.2 or better may take a graduate level course as a Technical or Computer Elective with the approval of their advisor, instructor of the course, and the Dean's office.

LIST 3.5.1: COMPUTER ELECTIVES

14:332:322	Principles of Communication Systems
14:332:346	Digital Signal Processing
14:332:376	Virtual Reality (14:332:378 is a co-requisite)
14:332:402	Sustainable Energy: choosing among options
14:332:415	Introduction to Automatic Control Theory (has not been offered since 2007, contact UG director)
14:332:417	Control System Design
14:332:421	Wireless Communication Systems (14:332:322 is a prerequisite)
14:332:423	Computer and Communication Networks
14:332:424	Introduction to Information and Network Security
14:332:435	Topics in ECE
14:332:436	Topics in ECE
14:332:443	Machine Learning for Engineers
14:332:445	Topics in ECE
14:332:446	Topics in ECE
14:332:447	Introduction to Digital Signal Processing Design
14:332:451	Introduction to Parallel and Distributed Programming
14:332:453	Mobile App Engineering and User Experience
14:332:456	Network-Centric Programming (usually offered only in alternate years)
14:332:472	Robotics and Computer Vision
14:332:474	Intro to Computer Graphics (This course is not offered often) (The course 198:428 can be taken in place)
14:332:479	VLSI Design
14:332:482	Deep Submicron VLSI Design for Electrical and Computer Engineering
14:332:491/2	Special Problems/Independent Study (not open to students on academic probation)
14:332:493	Topics in Electrical and Computer Engineering (if topic is computer related)
14:332:494	Topics in Electrical and Computer Engineering (if topic is computer related)
01:198:334	Introduction to Imaging and Multimedia
01:198:336	Principles of Information and Data Management
01:198:344	Design and Analysis of Computer Algorithms
01:198:440	Introduction to Artificial Intelligence

These courses are not offered often: 14:332:415, 14:332:474

LIST 3.5.2: TECHNICAL ELECTIVES

14:xxx: (where "xxx" is a departmental code): SOE 200+ level courses from other departments are accepted as technical electives;

14:332:382	Electromagnetic Fields
14:332:463	Analog Electronics
14:332:465	Physical Electronics
14:332:466	Opto-Electronic Devices
14:332:481	Electromagnetic Waves
14:332:491/2	Special Problems/Independent Study (not open to students on academic probation)

14:332:496/7 Co-Op and Internship (not open to students on academic probation)

01:640:250 Introductory Linear Algebra
01:640:311 Advanced Calculus I
01:640:312 Advanced Calculus II (640:421 Advanced Calculus for Engineers is not acceptable as this duplicate 332:345 Linear Systems and Signals)
01:640:350 Linear Algebra
01:640:351 Introduction to Abstract Algebra I
01:640:352 Introduction to Abstract Algebra II
01:640:354 Linear Optimization
01:640:357 Topics in Applied Algebra
01:640:373 Numerical Analysis I
01:640:374 Numerical Analysis II
01:640:403 Introduction to Theory of Functions of a Complex Variable
01:640:423 Elementary Partial Differential Equations (01:640:421 is not acceptable)
01:640:424 Stochastic Models in Operations Research
01:640:428 Graph Theory
01:640:454 Combinatorics
01:640:478 Mathematical Theory of Probability II

01:750:313 Modern Physics 01:750:351** Thermal Physics I
01:750:406 Introductory Solid-State Physics
01:750:417 Intermediate Quantum Mechanics
01:750:421 Fluid and Plasma Phenomena
01:750:464 Mathematical Physics

01:960:463 Regression Methods
01:960:467 Applied Multivariate Analysis
01:960:484 Basic Applied Statistics

01:160:307 Organic Chemistry I
01:160:308 Organic Chemistry II
10:160:314 Organic Chemistry Laboratory
01:160:315 Honors Organic Chemistry I
01:160:316 Honors Organic Chemistry II

01:198:213 Software Methodology
01:198:214 Systems Programming
01:198:314 Principles of Programming Languages
01:198:323* Numerical Analysis and Computing
01:198:417 Distributed Systems: Concepts and Design
01:198:424 Modeling and Simulation of Continuous Systems
01:198:439 Introduction to Data Science
01:198:440 Introduction to Artificial Intelligence
01:198:442 Topics in Computer Science
01:198:443 Machine Learning for Engineers
01:198:444 Topics in Computer Science
01:198:445 Topics in Computer Science
01:198:452 Formal Languages and Automata

07:211:330 Animation 3D

11:117:413 Unit Processes in Environmental Engineering I
11:117:414 Unit Processes in Environmental Engineering II
11:117:462 Design of Solid Waste Treatment Systems
11:117:474 Air Pollution Engineering

14:125:201 Introduction to Biomedical Engineering
14:125:208 Introduction to Biomechanics
14:125:255 Biomedical Engineering system Physiology

14:155:201 Chemical Engineering Material and Energy Balances
14:155:208 Chemical Engineering Thermodynamics I

14:180:216 Introductory Computer-Aided Design and Drafting
14:180:243 Mechanics of Solids

14:440:222 Engineering Mechanics: Dynamics
14:440:301 Introduction to Packaging Engineering
14:440:302 CAD for Packaging Engineering
14:440:371 Packaging Evaluation Methods
14:440:373 Packaging Manufacturing
14:440:378 Sustainable Packaging
14:440:392 Undergraduate Research in Engineering
14:440:403 Safety Engineering in Packaging
14:440:406 Packaging Printing and Decoration
14:440:468 Packaging Machinery
14:440:471 Distribution Packaging

14:540:201 Work Design and Ergonomics
14:540:210 Engineering Probability
14:540:320 Engineering Statistics
14:540:491 Special Problems

14:635:203 Introduction to Materials Science & Engineering (NB)
14:635:204 Materials Processing
14:635:205 Crystal Chemistry and Structure of Materials
14:635:206 Thermodynamics of Materials
14:635:212 Physics of Materials
14:635:303 Phase Diagrams
14:635:304 Ceramic Compositions
14:635:305 Materials Microprocessing
14:635:306 Processing III
14:635:307 Kinetics of Materials Processes
14:635:309 Characterization of Materials
14:635:312 Glass Engineering
14:635:314 Strength of Materials
14:635:316 Electronic, Optical and Magnetic Properties of materials
14:635:320 Introduction to Nanomaterials
14:635:321 Structural, Mechanical and Chemical Application of Nanostructures and Nanomaterials
14:365:322 Photonic, Electronic and Magnetic Applications of Nanostructures and Nanomaterials
14:635:330 Introduction to Nanomaterials
14:635:340 Electrochemical Materials and Devices

14:650:210 Introduction to Aerospace Engineering
14:650:231 Mechanical Engineering Computational Analysis and Design
14:650:291 Mechanics of Materials
14:650:388 Computer-Aided Design in Mechanical Engineering

Independent Study or Special Problems xxx:491, xxx:492, other than 332, are not, in general, considered as electives.

NOTEs:
* Credit not given for both 01:198:323-324 and 01:640:373-374
** Credit not given for both 01:750:351 and 14:650:351
***** Credit will not be given to 01:198:416**

For more info on topics courses, see **https://www.ece.rutgers.edu/undergraduate-course-descriptions**

3.6 List of Science, Math, and Engineering Electives

Science Math and Engineering Elective is any 3 Cr or 4 Cr course at 200 level or higher in any area of Science, or Mathematics, or Engineering. Although students are free to select this elective, they are encouraged to take a course that will later serve as a prerequisite for more advanced courses that would be of interest. There are several required courses in Math and Science. Any course lower level to the required courses is not allowed as a Science Math and Engineering Elective. Also, if a course qualifies as a Humanities course, it is not allowed as a Science Math and Engineering Elective.

The following is a list of courses where `x' represents any digit:

Departments/School	Courses
Accounting	33:010:2xx, 3xx, 4xx
Anthropology	01:070:2xx, 3xx, 4xx
Biological Sciences	01:115:2xx, 3xx, 4xx 01:119:2xx, 3xx, 4xx 01:126:2xx, 3xx, 4xx 01:146:2xx, 3xx, 4xx 01:694:2xx, 3xx, 4xx
Biotechnology	11:126: 2xx, 3xx, 4xx
Chemistry	01:160:2xx, 3xx, 4xx
Computer Science	01:198:2xx, 3xx, 4xx
Engineering (SOE)	14:xxx:2xx, 3xx, 4xx (Exception: 14:332:301 which counts as humanities)
Environmental Science	11:375:2xx, 3xx, 4xx
Food Science	11:400:2xx, 3xx, 4xx
Geography	01:4502xx, 3xx, 4xx
Geological Sciences	01:460:2xx, 3xx, 4xx
Genetics	01:447:2xx, 3xx, 4xx
Food Science	01:400:2xx, 3xx, 4xx
Marine Sciences	01:628:2xx, 3xx, 4xx
Mathematics	01:640:2xx, 3xx, 4xx
Physics	01:750:2xx, 3xx, 4xx
Science, Technology, and Society:	01:880: 2xx, 3xx, 4xx
Statistics	01:960:2xx, 3xx, 4xx

3.7 Courses Substitutions and Equivalence

Course Substitutions: Absolutely no substitutions are allowed for any required core courses. With permission of the Undergraduate Director, a student who fails a required course at Rutgers may take an equivalent course at another institution. For electives, a student can substitute equivalent courses from another institution with prior permission of the Undergraduate Director.

Equivalency of CS and ECE Courses: ***(Note: Starting with the class of 2022, new changes were introduced in the course equivalencies between CS and ECE programming sequences.)*** Regarding basic programming courses, a student needs to follow either the 7 credit ECE course sequence (332:252, 332:351), or the 7 credit CS sequence (198:111, 198:112).

Some important notes:

- 198:111 is based on Java while 332:252 (PM I) is based on C++.
- Students who take the CS courses 111, 112, and 213 (or 214) know more Java and less C (and related languages). On the other hand, students who take the ECE sequence 252, 254, and 351 know more C++ and less Java.
- For students considering the ECE+CS double major, the CS department accepts (332:252, 332:351) as a substitute for (198:111, 198:112). However, the CS department does not permit mixing and matching; a student must complete either the ECE sequence (332:252, 332:351) or the CS sequence (198:111, 198:112).
- Let us also emphasize that 198:111, 112 at Rutgers Camden are not equivalent to 198:111, 112 at New Brunswick; they are entirely different courses. The same applies to Rutgers Newark 198:101 and 198:102.
- Important: there is a residency requirement for ECE graduation and the CS courses will not count towards the 332:xxx residency requirement.

The following equivalences apply:

- **332:252** (Programming Methodology I): 198:111 (Introduction to Computer Science)
- **332:351** (Programming Methodology II): 198:112 (Data Structures)
- **14:332:312** (Discrete Mathematics): 01:198:205 (Introduction to Discrete Structures I) or 01:640:300 (Introduction to Mathematical Reasoning)
- **14:332:226** (Probability & Random Processes): 01:198:206 (Introduction to Discrete Structures II) or 01:640:477 (Mathematical Theory of Probability)

The following are no longer equivalent:

- 01:198:211 (Computer Architecture) is not accepted by the School of Engineering as being equivalent to **14:332:331** (Computer Architecture and Assembly Language). Please note that it is at the discretion of the CS department to accept 14:332:331 in lieu of 01:198:211 for their degree or minor.

3.8 Courses Prerequisite

The offering of courses in the summer is subject to instructor availability and enrollment and students should plan to complete coursework in the fall and spring semesters.

OFFERED	Course #	Course name	Prerequisite	Co-requisite
Fall; Spring	14:332:221	Principles of Electrical Engineering 1	(01:640:152 or 01:640:154 or 01:640:192) and (01:750:124 or 01:750:116 or 01:750:201 or 01:750:203 or 01:750:271)	14:332:223
Fall: Spring; Summer	14:332:222	Principles of Electrical Engineering 2	14:332:221 and 14:332:223 and (01:640:251 or 01:640:291) and (01:750:227) and (01:750:229)	14:332:224
Fall; Spring	14:332:223	Principles of Electrical Engineering 1 Laboratory	(01:640:152 or 01:640:154 or 01:640:192) and (01:750:124 or 01:750:116 or 01:750:201 or 01:750:203 or 01:750:271)	14:332:221
Fall: Spring; Summer	14:332:224	Principles of Electrical Engineering 2 Laboratory	14:332:221 and 14:332:223 and (01:640:251 or 01:640:291) and (01:750:227) and (01:750:229)	14:332:223
spring; summer	14:332:226	Probability and Random Processes	14:332:221 and (01:640:251 or 01:640:291)	N/A
Fall; Spring: Summer	14:332:231	Digital Logic Design	(14:440:127 or 01:198:111) and (01:640:152 or 01:640:154 or 01:640:192) and (01:750:124 or 01:750:116 or 01:750:201 or 01:750:203 or 01:750:271)	14:332:233
Fall; Spring; Summer	14:332:233	Digital Logic Design Laboratory	(14:440:127 or 01:198:111) and (01:640:152 or 01:640:154 or 01:640:192) and (01:750:124 or 01:750:116 or 01:750:201 or 01:750:203 or 01:750:271)	14:332:231
Spring; Summer	14:332:252	Programming Methodology I	14:440:127	
Spring	14:332:301	Wireless Revolution	Junior standing	
Fall; Spring	14:332:312	Discrete Mathematics	01:640:251 or 01:640:291	
Spring	14:332:322	Principles of	14:332:226 and 14:332:345	

		Communications Systems		
Fall; Spring; Summer(not guaranteed)	14:332:331	Computer Architecture and Assembly Language	14:332:231 and 14:332:233	14:332:333
Fall; Spring; Summer(not guaranteed)	14:332:333	Computer Architecture Laboratory	14:332:231 and 14:332:233	14:332:331
Fall; Spring; Summer	14:332:345	Linear Systems and Signals	14:332:222 and 14:332:224 and (01:640:244 or 01:640:252 or 01:640:292) and 14:440:127	
Spring	14:332:346	Digital Signal Processing	14:332:345 and 14:440:127	14:332:348
Spring	14:332:348	Digital Signal Processing Laboratory	14:332:345 and 14:440:127	14:332:346
Fall	14:332:351	Programming Methodology II	14:332:252	
Fall; Spring	14:332:361	Electronic Devices	14:332:222 and 14:332:224	14:332:363
Fall; Spring	14:332:363	Electronic Devices Laboratory	14:332:222 and14:332:224	14:332:361
Fall; Spring	14:332:366	Digital Electronics	14:332:361 and 14:332:363	14:332:368
Fall; Spring	14:332:368	Digital Electronics Laboratory	14:332:361 and 14:332:363	14:332:366
Spring	14:332:376	Virtual Reality	14:332:331	14:332:378
Spring	14:332:378	Virtual Reality Laboratory	14:332:331	14:332:376
Spring	14:332:382	Electromagnetic Fields	(01:640:152 or 01:640:154 or 01:640:192) and 01:750:227, and 14:332:222	
Spring	14:332:393	Professionalism/Ethics	Junior standing	
Fall	14:332:402	Sustainable Energy: Choosing among Options	Junior standing	
Spring	14:332:411	Electrical Energy Conversion	14:332:222 or 50:750:234	

Fall	14:332:417	Control Systems Design	14:332:345	
Fall	14:332:421	Wireless Communications	14:332:345	
Spring	14:332:423	Computer and Communication Networks	(14:332:226 or 01:198:206 or 01:640:477)	
Fall;	14:332:424	Introduction to Information and Network Security	14:332:226 and 14:332:312	
Spring	14:332:434	Introduction to Computer Systems	14:332:331 and 14:332:351	
Fall; Spring	14:332:435	Topics in ECE		
Fall; Spring	14:332:436	Topics in ECE		
Fall	14:332:437	Digital Systems Design	14:332:351 and 14:332:331	
Fall; Spring	14:332:445	Topics in ECE		
Fall; Spring	14:332:446	Topics in ECE		
	14:332:447	Digital Signal Processing Design	14:332:346	
Fall; Spring	14:332:448	Capstone Design in ECE	Senior standing	
Fall; **Spring**	14:332:449	Intro to Capstone Design	Senior Standing	
Fall	14:332:451	Introduction to Parallel and Distributed Programming	14:332:351 and 14:332:331	
Fall; Spring	14:332:452	Software Engineering	14:332:351	
	14:332:453	Mobile App Engineering and User Experience	14:332:351	
Spring	14:332:456	Network Centric Programming	14:332:351	
Fall	14:332:460	Power Electronics	14:332:361	
Fall	14:332:463	Analog Electronics	14:332:361	

Spring	14:332:464	RF Integrated Circuit Design	14:332:361 and 14:332:463	
Fall	14:332:465	Physical Electronics	14:332:361	
Fall	14:332:466	Optoelectronic Devices	14:332:361 and 14:332:382	
Spring	14:332:467	Microelectronic Processing	14:332:361	
Fall	14:332:472	Robotics and Computer Vision	14:332:345 and 14:332:346	
	14:332:474	Introduction to Computer Graphics	14:332:252	
Fall	14:332:479	VLSI Design	14:332:331 and 14:332:252 and 14:332:366	
Fall	14:332:481	Electromagnetic Waves	14:332:382	
Fall	14:332:491	Special Problems: Independent Study	Permission of department	
Spring	14:332:492	Special Problems: Independent Study	Permission of department	
Fall; Spring	14:332:493	Topics in Electrical and Computer Engineering		
Fall; Spring	14:332:494	Topics in Electrical and Computer Engineering		
Fall; **Spring**	14:332:495	Internship in Electrical and Computer Engineering	Permission of department	
Spring	14:332:496	Co-op Internship in Electrical and Computer Engineering	Permission of department.	
Fall	14:332:497	Co-op Internship in Electrical and Computer Engineering	Permission of department.	

3.9 Capstone Design Course

Capstone design program, or engineering design project, marks an important milestone in the ECE undergraduate student education. Senior year students engage in a year-long design project held in the fall and spring semester. Teams of three to four students work on real-life problems, focused on putting fundamental knowledge accumulated along the years with know-hows of engineering. Students get an opportunity to develop an engineering project from idea inception to a fully operational product. A faculty adviser, at times in collaboration with an industry adviser or other representatives from other departments, works with the students on design and implementation of cutting-edge technology and research.

The program starts in the fall semester with a 1-credit course “Introduction to Capstone Design” (14:332:449) that involves a series of sessions that cover the following:

1. **Information orientation session:** setting up program timeline for the fall including teaming up, choosing a project, finding an advisor and submitting proposal. Previous years projects are reviewed and guidelines for the spring preparations are shared.
2. **Project management workshop:** fast-track workshop on projects management based on the SMART (Specific, Measurable, Achievable, Relevant and Timely) way has been added to the curricula along with an introduction to the use of project management tools. Students are guided on defining an appropriate scope of work (SOW), writing a proposal, and choosing the appropriate topic and team members for the project.
3. **Networking sessions:** faculty and industry panels are being organized to introduce potential advisers to the students and enable them to brainstorm on their ideas with professionals from the academia and industry:
    a. **Faculty panels**: Two one-hour sessions are held in September and October. Faculty introduce themselves to students and talk about their research background, past capstone projects they advised on, and topics they are interested to work on.
    b. **Capstone Kickoff event**: this industry/faculty networking events includes professionals from diverse industries. It served as a great opportunity for professionals from diverse industries to meet with senior students and learn about their design projects and offer expert advice

By December of the fall semester all students team-up, submit a project proposal, have an adviser and are registered to one of the Capstone Design course sections. The Capstone Design course is normally held during senior year in the spring semester. Students sign up to 14:332:448:xx course. Each ECE faculty is assigned a capstone design their own course section in the form 14:332:448:xx, where xx represent a section number unique to each advisor. Signed up to the course is made using special permission numbers given by the faculty advising the students. The project advisor should assign each team with a set of special permission numbers, one for each of the team members. The ECE faculty will provide the students with the appropriate Capstone Design course index and special permission numbers for registration.

In the spring semester, the students have predefined milestones, deliverables and need to operate under time and budget constraints. All these are defined in the 'Capstone Design Projects Handbook' and available at: http://www.ece.rutgers.edu/ece-capstone.

There are in general no specific prerequisites for capstone courses except for successful completion of EE/CE core courses. However, some recommendations for electives tracks are detailed hereafter.

For questions regarding registration, contact ECEUndergradDirector@soe.rutgers.edu.

3.10 Courses listing by relevancy:

The ECE courses can be classifying in general into several recommended combination per the fields of interest as follows:

Field of electromagnetics and optoelectronics topic: 14:332:382 Electromagnetic Fields; 14:332:466 Optoelectronics; 14:332:481 Electromagnetic Waves; 14:332:465 Physical Electronics 14:332:463 Analog Electronics

Field of Electronic Circuits: 14:332:460 Power Electronics; 14:332:463 Analog Electronics; 14:332:465 Physical Electronics

Field of Microelectronic Processing: 14:332:460 Power Electronics; 14:332:463 Analog Electronics 14:332:465 Physical Electronics; 14:332:467 Intro to Microelectronic Processing

Communication Systems field - Hardware: 14:332:322 Principles of communication systems; 01:640:250 Intro to Linear Algebra; 14:332:421 Wireless Communication Systems; 14:332:427 Communication System Design; 14:332:423 Computer and Communication Networks; 14:332:424 Intro to Information and Network Security

Field of Wireless Communication Systems: 14:332:322 Principles of communication systems; 01:640:250 Intro to Linear Algebra; 14:332:421 Wireless Communication Systems; 14:332:427 Communication System Design; 14:332:423 Computer and Communication Networks; 14:332:424 Intro to Information and Network Security

Field of Automatic Control: 14:332:346 Digital Signal Processing; 01:640:250 Intro to Linear Algebra; 14:332:415 Intro to Automatic Control ; 14:332:417 Control System Design
14:332:463 Analog Electronics

Digital Signal Processing: 14:332:346 Digital Signal Processing; 01:640:250 Intro to Linear Algebra; 14:332:447 Digital Signal Processing Design; 14:332:463 Analog Electronics

VLSI Design: 14:332:460 Power Electronics; 14:332:465 Physical Electronics; 14:332:467 Microelectronic Processing; 14:332:479 VLSI Design; 14:332:482 Deep Submicron VLSI Design

VLSI Design and Microelectronic Processing: Those students interested in coupling Microelectronic Processing with VLSI Design can follow the schedule given below: 14:332:460 Power Electronics; 14:332:465 Physical Electronics; 14:332:467 Microelectronic Processing; 14:332:479 VLSI Design; 14:332:482 Deep Submicron VLSI Design

Robotics and Computer Vision: 14:332:346 Digital Signal Processing; 01:640:250 Intro to Linear Algebra; 14:332:472 Intro to Robotics and Computer Vision

Software and Systems: 14:332:452 Software Engineering; 14:332:456 Network-Centric Programming; 14:332:451 Intro to Parallel and Distributed Programming

1. General Information

4.1 Pass/No Credit Courses (http://soe.rutgers.edu/oas/pnc-repeat):

Pass/Fail or Pass/No Credit - An engineering student may take one elective course on a Pass/Nocr basis in any two terms of the curriculum (meaning, only 1 Pass/Nocr in a semester). Grades of A, B, and C correspond to Pass, and D and F correspond to No-Credit. A No-credit is like a failure in that it cannot count towards anything for graduation. Note that ECE Departmental courses are not eligible for pass/nocr for ECE students.

4.2 Repeating Courses (http://soe.rutgers.edu/oas/pnc-repeat):

A grade of D or F received in any course (except for Capstone Design) may be "E-credited" by retaking the class AT Rutgers. This means that the original grade (D or F) will not count in any GPA calculation. You will however still see both courses and the grades denoted on the transcript. If you choose to retake the course outside of Rutgers University, the course is not eligible for E-credit. This may be done with up to 4 courses.

D grades and E-credit: Students must repeat a course, particularly when the grade is a D, right away. If the student earns a D in a course and then moves on in subsequent coursework, removing the D from the gpa is no longer an option.

4.3 Transfer Credits (http://soe.rutgers.edu/oas/transfer-courses):

Certain courses can be taken at other universities and the credits can be transferred to Rutgers. Courses eligible to be taken outside of RU during the summer/winter include first and second year courses of the engineering curriculum: math, physics, chemistry, humanities/social science electives, non-school 14 tech electives, sophomore level introductory major courses. However, it is not recommended to take two math courses in one summer, particularly for students having academic difficulty. The transfer credits are not computed into a student's grade point average. However, if the grade is **C** or better, it does satisfy the requirement. For more information related to transfer credits, students are directed to contact the School of Engineering Undergraduate Education/Academic Services.

4.4 Graduate Courses:

Certain graduate courses can be taken for undergraduate credit and used as departmental or technical electives. An application must be filled out and approved by the Graduate Director before a student can enroll in a graduate course.

4.5 Prerequisites:

Students should NOT register for a course if the needed prerequisite course(s) have not been successfully completed. The department has the option of dropping a student from a course if he/she has not fulfilled the prerequisite requirements, even after the course has successfully been completed.

4.6 Prerequisite Chart:

To review the required prerequisites for each course, please see the prerequisite chart included in the handbook in Appendix A.

4.7 Withdrawing from Courses:

Unfortunately, some students encounter major problems during their college career. Seek help before you are dismissed from the School of Engineering. If you find that you are unable to complete the required work, speak to an advisor, the Undergraduate Director, or the Associate Dean. Make use of the many resources available to you at Rutgers. Please take responsibility for your situation by seeking help if you need it.

Here is the rule: If you fail a course, it is computed into your university and major grade point averages - a withdrawal is not.

You may withdraw from courses up to the 8th week of the term by telephone or on the web. Between the 8th and 12th weeks, you may withdraw with the permission of the Associate Dean, if, for example, you are severely behind in your coursework. After the 12th week, permission from the Dean is required and your reason for withdrawal must be significant and considered beyond your control.

4.8 The Major Average:

All courses offered by the Department of Electrical and Computer Engineering and all technically oriented electives are considered as major courses. In order to graduate, your major average must be 2.00 or better.

If you fail a course and then repeat it, both grades are computed into the major average as well as the university average. When registering, be sure to place an "M" next to the technically oriented electives on the registration card. The computer system cannot keep track of all the possible technical electives.

4.9 Academic Standing (http://soe.rutgers.edu/oas/scholasticstanding):

After the fall and spring semesters (not after summer), the Committee on Student Scholastic Standing, composed of elected faculty and representatives of the deans in the School of Engineering, reviews and may take action on the record of every student whose semester GPA, cumulative GPA, or major GPA is 2.0 or lower. Students who were placed on probation at the end of the previous term also are reviewed. These students may be placed on probation or may be dismissed from the School of Engineering. Students will be notified in writing of their academic standing. For students who are not performing at an acceptable level (Standards of Academic Progress-SAP), this may affect your financial aid, and may require an academic plan.

4.10 Academic Dishonesty:

The department expects each student to conduct himself/herself in a professional manner. Cheating offenses are reported to the appropriate academic office by the faculty of Electrical and Computer Engineering without hesitation. An engineer beginning a career cannot afford to have this kind of incident on record. Both the student who gives information and the one who receives it are considered guilty parties. The University policy on academic dishonesty is carefully spelled out in the undergraduate catalog. Note that copying from, or giving assistance to others, or using forbidden material on any exam or in any required report, is a Level Three violation. The recommended sanction is suspension from the University for one or more terms with a notation of academic disciplinary suspension placed on the student's transcript.

2. Additional Information

SOE Dean's website: You can find general and useful info about Dean's office at http://soe.rutgers.edu/oas**.**

Contact Information:

SOE Office of Academic Services: **http://soe.rutgers.edu/** 848-445-2212

Registrar (SOE): http://registrar.rutgers.edu/NBINDEX.HTM 848-445-3557

ECE Department: http://www.ece.rutgers.edu (main menu: Academics/Undergraduate)

ECE Undergraduate Director: ECEUndergradDirector@soe.rutgers.edu 848-445-0606