

RUTGERS

School of Engineering

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Handbook for Undergraduate Students in Electrical and Computer Engineering

This handbook can be found at
the [ECE](#) website

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Handbook for Undergraduate Students

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 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/oa>.

The undergraduate program consists of two specific options: (1) Electrical Engineering option and (2) Computer Engineering 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. The four categories of elective courses are (1) Technically oriented electives, (2) Science Math and Engineering elective, (3) Humanities/Social Science electives and (4) General elective.

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, to prepare its graduates for rapidly changing technological fields, and give them 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:

Both Electrical Engineering and Computer Engineering options 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 requirements: to satisfy the requirements for graduation a minimum number of 14:332:xxx credits must be taken. Students majoring in the Electrical Engineering option and the Computer Engineering option need to take **54 credits of 14:332:xxx**. Only core courses and electrical and computer electives count towards residency requirements. Technical electives do not count towards

residency. Core courses are detailed in the Electrical and Computer Engineering Curriculum detailed herein.

Required Number of Electives for the ECE major:

Electrical Engineering Option:

Electives consists of (1) **four** courses of electrical electives, (2) **two** courses of technical electives, (3) **one** course of Science Math and Engineering elective, and (4) **one** course of a general elective.

Computer Engineering Option:

Electives consist of (1) **two** courses of computer electives, (2) **one** course of computer or technical elective, (3) **one** course of technical elective, and (4) **one** course of Science Math and Engineering elective.

For all SOE majors, students must take 18cr of humanities/social science requirements, including 12cr of electives: **two** courses of lower level Hum/Soc electives and **two** courses of upper level Hum/Soc electives. Humanities/Social Science requirements are not a part of the ECE Residency requirement.

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 faculty of the department of Electrical and Computer Engineering strives to educate and train the students in a technically sound and challenging manner to achieve the following *educational objectives*:

1. To prepare graduates to pursue professional careers or continue their education in graduate programs.
2. To ensure that graduates are proficient and competent in the following electrical and computer engineering areas: communications, computer engineering, computer signal and information processing, systems and controls, and solid state electronics.
3. To produce graduates who will pursue life-long learning and professional development.

1.4 Educational Outcomes

Rutgers ECE graduates should have attained:

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) an ability to function on multi-disciplinary teams
- (e) an ability to identify, formulate, and solve electrical and computer engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of electrical and computer engineering solutions in a global, economic, environmental, and societal context

- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for electrical and computer engineering practice.

1.5 The Relationship Between Educational Objectives and Outcomes

Relationship between Educational Objectives and Outcomes

(Dark = Highly Related, Gray = Supportive, White = None)

Objective \ Outcome	(1) To prepare graduates to pursue professional careers or continue their education in graduate programs.	(2) To ensure that graduates are proficient and competent in at least one of the following electrical and computer engineering areas: communications, computer engineering, digital signal processing, systems and control, and solid-state electronics.	(3) To produce graduates who will pursue life-long learning and professional development.
(a) Ability to apply knowledge of math, science and engineering.	Dark	Dark	Gray
(b) Ability to design and conduct experiments, analyze and interpret data.	Dark	Dark	Gray
(c) Ability to design a system, component, or process to meet desired needs within realistic constraints.	Dark	Dark	Gray
(d) Ability to function in multidisciplinary teams.	Dark	White	Gray
(e) Ability to identify, formulate, and solve electrical and computer engineering problems.	Dark	Dark	Dark
(f) Understanding of professional and ethical responsibility.	Dark	White	Gray
(g) Ability to communicate effectively.	Dark	Dark	Dark
(h) Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	Gray	Gray	Dark
(i) Recognition of need for and an ability to engage in life-long learning	White	Gray	Dark
(j) Knowledge of contemporary issues.	Gray	White	White
(k) Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	Dark	Dark	Gray

Course VS Course Outcomes

N = none S = Supportive H = highly related

Course	COURSE OUTCOMES											OTHERS					
	a	b	c	d	e	f	g	h	i	j	k	1	2	3	4	5	6
221 Principles Of EE I	H	N	N	N	H	N	N	N	S	N	H	H	S	N	N	S	S
222 Principles Of EE II	H	S	N	N	H	N	S	N	S	N	H	H	N	S	N	S	S
223 Principles Of EE I Lab	H	H	S	H	S	S	H	N	S	N	H	H	S	N	N	H	S
224 Principles Of EE II Lab	H	H	S	H	S	S	H	N	S	N	H	H	S	S	N	H	S
226 Probability and Random Processes	H	S	H	N	H	N	S	N	S	N	H	H	S	H	S	S	S
231 Digital Logic Design	H	H	S	N	H	S	S	N	S	N	H	S	S	H	H	H	S
233 Digital Logic Design Lab	H	H	H	H	H	S	H	N	S	N	H	S	S	H	H	H	S
252 Prog. Methodology I	H	N	N	N	H	N	S	N	S	N	H	N	N	H	S	H	S
254 Prog. Methodology II Lab	H	H	S	N	S	S	S	N	S	N	H	N	N	H	S	H	S
301 Forces and Strategies that Shaped the Wireless Revolution	S	S	S	H	S	H	H	H	H	H	S	S	S	N	N	N	H
312 Discrete Mathematics	H	N	N	N	H	N	S	S	N	N	N	N	N	H	S	N	H
322 Principles of Communication Systems	H	N	S	N	H	N	S	S	S	N	H	H	S	N	N	N	S
331 Computer Architecture	H	S	N	N	H	N	S	N	S	N	H	H	S	H	H	S	S
333 Comp. Architecture Lab	H	H	N	S	H	N	S	N	S	N	H	H	S	H	H	H	N
345 Linear Systems & Signals	H	N	S	N	H	N	H	N	S	N	H	H	H	S	N	S	S
346 Digital Signal Processing	H	N	S	N	H	N	S	N	S	N	H	H	S	H	S	H	S
347 Linear Sys. & Signals Lab	H	H	S	N	S	S	H	N	S	N	H	H	S	S	N	H	S
348 Digital Signal Proc. Lab	H	S	S	N	H	N	S	N	S	N	H	H	S	H	S	H	S
351 Prog. Methodology II	H	N	N	N	H	N	S	N	S	N	H	N	N	H	S	H	S
361 Electronic Devices	H	S	N	N	H	N	S	N	S	N	H	H	S	S	N	S	S
363 Electronic Devices Lab	H	H	S	S	S	S	H	N	S	N	H	H	S	S	N	H	S
366 Digital Electronics	H	S	N	N	H	N	S	N	S	N	H	H	S	H	S	S	S

368 Dig. Electronics Lab	H	H	S	S	S	S	H	N	S	N	H	H	S	H	S	H	S
373 Elements of EE	H	N	N	N	S	N	N	N	S	N	S	S	S	N	N	S	S
375 Elements of EE Lab	H	S	S	H	S	N	H	N	S	N	H	S	S	N	N	H	S
376 Virtual Reality	H	S	S	N	H	N	S	S	S	N	H	S	S	S	N	S	S
378 Virtual Reality Lab	H	S	N	H	H	N	S	S	S	N	H	H	S	S	S	H	S
382 Electromagnetic Fields	H	N	N	N	H	N	N	S	N	S	H	H	S	N	N	S	S
393 Professionalism/Ethics	N	N	N	N	N	H	N	S	S	S	N	N	N	N	N	N	N
402 Sustainable Energy	S	S	H	H	S	H	H	H	H	H	S	S	N	N	N	N	H
411 Energy Conversion	H	S	N	N	H	N	S	N	S	N	H	H	S	N	N	S	S
415 Automatic Control Systems	H	N	S	N	H	N	H	N	S	N	H	H	H	S	N	S	S
417 Control System Design	H	N	S	N	H	N	H	N	S	N	H	H	H	H	N	S	S
421 Wireless Communications	H	H	H	H	H	H	H	S	S	S	H	H	S	N	N	N	S
423 Comp. & Comm. Networks	H	H	N	S	H	N	S	N	S	N	H	H	S	H	S	S	S
424 Info & Network Security	H	S	S	S	H	N	H	N	S	S	S	H	S	H	S	H	S
427 Comm. System Design	H	H	S	S	H	S	H	N	S	N	H	H	S	N	N	H	S
434 Intr. to Comp Systems	H	N	N	N	H	N	N	N	S	N	H	N	N	H	H	N	S
437 Digital System Design	H	S	N	N	H	N	S	N	S	N	H	S	S	H	H	S	S
447 Dig. Signal Proc. Design	S	H	H	H	H	H	H	H	S	H	H	H	H	S	S	S	S
448 Cap. Des.- in ECE	H	H	H	H	H	S	H	S	H	S	H	H	H	S	N	H	S
451 Parallel & Distributed Prog.	H	H	S	H	H	N	S	N	S	N	H	N	N	H	H	S	S
452 Software Engineering	H	H	H	H	H	S	H	S	S	S	H	N	N	H	H	H	S
453 Mobile App Engineering	H	S	H	S	H	S	S	N	S	H	H	N	N	H	H	H	S
456 Network Centric Prog.	H	S	N	N	H	N	S	N	S	S	H	N	S	H	H	H	S
460 Power Electronics	H	H	S	S	H	S	S	N	S	N	H	H	S	N	N	S	S
463 Analog Electronics	H	N	N	N	H	N	S	N	S	N	H	H	H	N	N	H	S
464 RF Integrated Circuits	H	N	S	N	H	N	S	N	S	N	H	H	H	N	N	N	S
465 Physical Electronics	H	S	N	N	H	N	S	N	S	N	H	H	S	N	N	N	S
466 Optoelectronics	H	N	N	N	H	S	S	S	S	S	H	H	S	N	N	S	S

467 Microelec. Processing	H	H	S	S	H	S	H	N	S	N	H	H	S	N	S	H	S
472 Robotics & Comp. Vision	H	S	H	H	H	N	S	N	S	N	H	H	S	S	H	S	S
474 Computer Graphics	H	S	S	N	H	N	S	N	S	N	H	S	S	S	H	S	S
478 Capstone Design - Virtual Medical Systems	H	H	H	H	H	S	H	S	S	S	H	H	H	H	H	H	S
479 VLSI Design	H	H	N	N	H	N	S	N	H	N	H	H	H	H	H	H	S
481 EM Waves	H	S	H	N	H	S	S	S	S	S	H	H	S	N	N	S	S
482 Deep Submicron VLSI Des	H	H	N	N	H	N	S	N	H	N	H	H	H	H	H	H	S
491-492 Special Probs/ Independent Res.	H	H	N	N	H	S	H	S	S	S	H						
496-497 Co-Op Internship	H	H	H	H	H	H	H	S	S	S	H						

Course Outcomes:

- (a) an ability to apply knowledge of Mathematics, science, and engineering
- (b) an ability to design and conduct experiments and interpret data
- (c) an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) an ability to function as part of a multi-disciplinary team
- (e) an ability to identify, formulate, and solve ECE problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate in written and oral form
- (h) the broad education necessary to understand the impact of electrical and computer engineering solutions in a global, economic, environmental, and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for electrical and computer engineering practice

Other Outcomes:

1. Basic disciplines in Electrical Engineering
2. Depth in Electrical Engineering
3. Basic disciplines in Computer Engineering
4. Depth in Computer Engineering
5. Laboratory equipment and software tools
6. Variety of instruction formats

2. Combined Degree Options, Minors and Double Majors

2.1 **BS/Master's programs (<http://soe.rutgers.edu/oas/BS-Masters>):**

Rutgers School of Engineering students are eligible to apply for admission to a variety of accelerated Master's Programs. Admission to any of these programs typically requires a cumulative grade point average of at least 3.2 (*note: some departments have different GPA requirements*) and junior year status. In some cases, an aptitude test such as the GRE or GMAT is also required. These prestigious programs allow students to complete a master's degree in 1-2 extra years while simultaneously integrating an undergraduate engineering experience with that of a graduate program. With the higher demands of the work place in today's world, the B.S./Master's programs ensure that students remain competitive by mastering new techniques and extending their expertise within their subject area and/or in the related areas of business.

There are currently three combined programs available with a B.S. in Engineering. See the following links for details:

- [BS-MBA](#) (Master of Business Administration - Future Leaders MBA)
- [BS-MS/ME](#) (Master of Science, or Master of Engineering): described in 2.5
- [BS-MBS](#) (Master of Business and Science)
- [BS-MEd](#) (Master of Education)

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

Minors, majors, and dual degrees provide students with the opportunity to broaden skill sets outside of engineering. Often times 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 suggested choice for Computer Option Students enabling a CS minor is as follows:

Students enrolled in the Computer Engineering Option: Take 198:111, 112, 213/214, and **three** electives as either Computer electives or Tech electives or a combination of them. These electives are to be taken among the courses listed as technical elective. Substitute 198:111, 112, 213/214 for ECE required courses 332:252, 254 and 351 (PM I & LAB and PM II). You may take a CS course as Science Math Engineering elective.

Students should check with CS departmental advisor before finalizing their schedules.

Students enrolled in the Electrical Engineering Option: It is rather difficult to take a minor in CS unless you are prepared to take six extra CS courses. Consult the UG Director.

Note that with any substitution of an ECE course: ECE students need to take 54 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 have to 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 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: ECE students need to take 54 credits of 14:332:xxx.

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 with the help of some gauges know whether it needs GAS or OIL, and also be familiar 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 BS-MS Program:

The admission Process for combined BS/MS Degrees is described below.

1. ECE undergraduate students in a good academic standing with the GPA of 3.2 and above are eligible for admission in to the ECE graduate program.
2. The interested student needs to submit the regular New Brunswick Graduate School application at the beginning of the fall semester of senior year to the ECE Graduate Director together with three letters of recommendation. The GRE requirement will be waived.
3. Students must complete the number of credits required for the ECE BS degree before starting the M.S. graduate program. The requirements for the MS degree are identical to the requirements in effect for regular ECE MS students:
 - (a) 24 credits plus the master thesis or
 - (b) 30 credits plus the master technical paper and its public presentation.

Please note that double counting of credits **for both degrees is presently not allowed**. Also, this is not a joint BS/MS 5-year program. Such a program will need the approval from the State.

3 ECE Program Courses Information

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

3.1 Electrical Engineering Curriculum:

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 Math/Phy	4
14:440:100	Engineering Orientation	1	01:750:124	Analytical Physics IB	2
01:640:151	Calculus I Math/Physics	4	<u>01:220:102</u>	Introduction to Microeconomics	3
01:750:123	Analytical Physics IA	2			
<u> : : </u>	Hum/Soc elective	3			
<u>Total Credits</u>		17	<u>Total Credits</u>		15

Sophomore Year

14:332:221	Principles of Electrical Eng. I	M 3	14:332:222	Principles of Electrical Eng. II	M 3
14:332:223	Principles of E.E. I Lab	M 1	14:332:224	Principles of E.E. II Lab	M 1
14:332:231	Digital Logic Design	M 3	14:332:226	Probability & Random Processes	M 3
14:332:233	Digital Logic Design Lab	M 1	14:332:252	Programming Methodology I	M 3
01:640:251	Multivariable Calculus	4	14:332:254	Programming Method. I. Lab	M 1
01:750:227	Analytical Physics IIA	3	01:640:244	Differential Equations for Eng/Phy	4
01:750:229	Analytical Physics II Lab	1			
<u>Total Credits</u>		16	<u>Total Credits</u>		15

Junior Year

14:332:331	Computer Arch.& Asmb. Lang.	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 Processing Lab	M 1
14:332:347	Linear Systems & Signals Lab	M 1	14:332:393	Professionalism/Ethics	M 1
14:332:361	Electronic Devices	M 3	14:332:366	Digital Electronics	M 3
14:332:363	Electronic Devices Lab	M 1	14:332:368	Digital Electronics Lab	M 1
<u> : : </u>	Hum/Soc elective	3	14:332:_____	Electrical elective	M 3
			<u> : : </u>	Technical elective	M 3
<u>Total Credits</u>		15	<u>Total Credits</u>		18

Senior Year

14:332:___	Electrical elective	M	3	14:332:448	Capstone Design elective	M	3
14:332:___	Electrical elective	M	3	14:332:___	Electrical elective	M	3
: :	Science Math Engg elective	M	3	_: :_	General elective		3
: :	Technical elective	M	3	_: :_	Hum/Soc elective 300+		3*
: :	Hum/Soc elective 300+		3*				
	14:440:487 or 14:440:488 Senior Survey is required for graduation						
<u>Total Credits</u>			15	<u>Total Credits</u>			12

Total degree credits: 123

Electives consists of (1) four courses of electrical electives, (2) two courses of Technical electives, (3) one course of Science Math Eng'g elective, (4) two courses of lower level Hum/Soc electives, (5) two courses of upper level Hum/Sci electives denoted by * (not all four humanity electives can be in the same subject), and (6) one course of general elective. For more info on humanity electives, see <http://soe.rutgers.edu/oa/electives>

Most ECE courses are offered only once a year in the indicated semesters. Odd numbered ECE courses are offered in Fall and even numbered in Spring (some exceptions may happen, e.g., 466, 472 are offered in Fall). 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 must.

Independent study courses 14:332:491 and 14:332:492: up to six credits are acceptable: three (3) credits for electrical/computer electives and three (3) credits as a technical elective.

Co-op and 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 are acceptable with 14:332:491, 14:332:492, 14:332:496 and 14:332:497 courses.

3.2 Computer Engineering Curriculum:

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 Math/Phy	4
14:440:100	Engineering Orientation	1	01:750:124	Analytical Physics IB	2
01:640:151	Calculus I Math/Physics	4	<u>01:220:102</u>	Introduction to Microeconomics	3
01:750:123	Analytical Physics IA	2			
<u> </u>	Hum/Soc elective	3			
<u>Total Credits</u>		17	<u>Total Credits</u>		15

Sophomore Year

14:332:221	Principles of Electrical Eng. I	M 3	14:332:222	Principles of Electrical Eng. II	M 3
14:332:223	Principles of E.E. I Lab	M 1	14:332:224	Principles of E.E. II Lab	M 1
14:332:231	Digital Logic Design	M 3	14:332:226	Probability & Random Processes	M 3
14:332:233	Digital Logic Design Lab	M 1	14:332:252	Programming Methodology I	M 3
01:640:251	Multivariable Calculus	4	14:332:254	Programming Method. I. Lab	M 1
01:750:227	Analytical Physics IIA	3	01:640:244	Differential Equations for Eng/Phy	4
01:750:229	Analytical Physics IIA Lab	1			
<u>Total Credits</u>		16	<u>Total Credits</u>		15

Junior Year

14:332:331	Computer Arch.& Asmb. Lang.	M 3	14:332:312	Discrete Mathematics	M 3
14:332:333	Computer Arch. Lab	M 1	14:332:366	Digital Electronics	M 3
14:332:345	Linear Systems & Signals	M 3	14:332:368	Digital Electronics Lab	M 1
14:332:347	Linear Systems & Signals Lab	M 1	14:332:452	Software Engineering	M 3
14:332:361	Electronic Devices	M 3	14:332:393	Professionalism/Ethics	M 1
14:332:363	Electronic Devices Lab	M 1	14:332:434	Intro to Computer Systems	M 3
14:332:351	Programming Methodology II	M 3	<u> </u>	Computer/Tech elective	M 3
<u>Total Credits</u>		15	<u>Total Credits</u>		17

Senior Year

14:332:437	Digital System Design	M	3	14:332:448	Capstone Design elective	M	3
<u> </u>	Computer elective	M	3	<u> </u>	Computer elective	M	3
<u> </u>	Tech elective	M	3	<u> </u>	Hum/Soc elective		3
<u> </u>	Science Math Engg elective	M	3	<u> </u>	Hum/Soc elective 300+		3*
<u> </u>	Hum/Soc elective 300+		3*				
	14:440:487 or 14:440:488 Senior Survey is required for graduation						
<u>Total Credits</u>			15	<u>Total Credits</u>			12

Total degree credits: 122

Electives consists of (1) two courses of computer electives, (2) one course of technical elective, (3) one course of either computer or technical elective, (4) one course of Science Math Eng'g elective, (5) two lower level Hum/Soc electives, and (6) two upper level Hum/Soc electives denoted by * (not all four humanity electives can be in the same subject). For more info on humanity electives, see <http://soe.rutgers.edu/oa/electives>

The ECE courses are offered only once a year in the indicated semesters. Odd numbered ECE courses are offered in Fall and even numbered in Spring (some exceptions may happen, e.g., 466 and 472 are offered in Fall). 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 must.

Independent study courses 14:332:491 and 14:332:492: up to six credits are acceptable: three (3) credits for electrical/computer electives and three (3) credits as a technical elective.

Co-op and 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 are 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 courses 14:332:491 and 14:332:492. Three (3) credits will count as either electrical/computer elective (three credits maximum) and three (3) credits as technical electives (three credits maximum), 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 to the Undergraduate Director at the end of the study.

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

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.

Upon successful completion, six credits can be used as **technical elective**.

An option for a three months Co-Op is also available for either fall or spring semester. In such case, three credits are earned that will count for a technical elective.

Students who plan to enroll in a Co-Op Internship should review the guidelines specified under the course heading 14:332:496/497 Co-Op Internship in Electrical and Computer Engineering. 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 (848) 445-6127.

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.

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. In

order to earn credit, the student must be working on a specified and approved project. A one-page description of the project and an application form appropriately filled must be submitted for approval to the Undergraduate Director. Additionally, the student must have a faculty advisor as well as an industrial advisor who will supervise the student. At the end of the project, a technical report must be written, and a copy of it must be submitted to the Undergraduate Director as well as to the industrial advisor who together decide whether the student is to receive a passing grade or not.

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

- 3.3.4 **Humanities/Social Science Requirements:** all SOE majors must take a total of 18cr 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 Forces and Strategies That Shaped the 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, nor a part of 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 Each 4-credit Computer Science (Livingston College) course constitutes one elective course.
- 3.3.5 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 198:213 or 198:214 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
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
14:332:434	Introduction to Computer Systems
14:332:427	Communication System Design
14:332:437	Digital System Design
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 or 640:428 can be taken in place of 332:474)
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)

LIST 3.4.2: TECHNICAL ELECTIVES

14:332:491/2 Special Problems/Independent Study (not open to students on academic probation; maximum 3 credits as Technical Elective)

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

01:640:250 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

01:640:454 Combinatorics

01:640:478 Mathematical Theory of Probability II

01:750:313 Modern Physics I

01:750:314 Modern Physics II

01:750:351** Thermal Physics I

01:750:352 Thermal Physics II

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

01:160:316 Honors Organic Chemistry II

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

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

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)
14:332:382	Electromagnetic Fields
14:332:402	Sustainable Energy: choosing among options
14:332:415	Introduction to Automatic Control Theory (This course is not offered often)
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
14:332:447	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 (The course 198:428 or 640:428 can be taken in place of 332:474)
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

LIST 3.5.2: TECHNICAL ELECTIVES

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)
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
01:640:454	Combinatorics
01:640:478	Mathematical Theory of Probability II
01:750:313	Modern Physics I
01:750:314	Modern Physics II
01:750:351**	Thermal Physics I
01:750:352	Thermal Physics II
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
01:160:316	Honors Organic Chemistry II
01:198:323*	Numerical Analysis and Computing
01:198:417	Distributed Systems: Concepts and Design
01:198:424	Modeling and Simulation of Continuous Systems
01:198:476	Advanced Web Applications: Design and Implementation

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

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

3.6 Capstone Design Course

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. With any questions regarding registration please contact Dr. Godrich (godrich@rci.rutgers.edu).

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.

There are several possible tracks in ECE. Here are some optional tracks:

Electromagnetics and optoelectronics:

14:332:382 Electromagnetic Fields

14:332:466 Optoelectronics

14:332:481 Electromagnetic Waves

14:332:465 Physical Electronics

14:332:463 Analog Electronics

Electronic Circuits:

14:332:460 Power Electronics

14:332:463 Analog Electronics

14:332:465 Physical Electronics

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 - 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

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

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

3.7 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	Notes
Accounting	33:010:2xx, 3xx, 4xx	
Anthropology	01:070:2xx, 3xx, 4xx	There are several Anthropology courses accepted as Humanity courses. They are not allowed as science Math Engineering electives. To be definite, the following Anthropology courses are accepted as Science Math Engineering electives: 291-294, 334, 335, 349, 354, 355, 358, 359, 390-395, 495-498
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:2xxx, 3xxx, 4xxx	Exception: 14:332:301 which counts humanities
Environmental Science	11:375:2xx, 3xx, 4xx	
Food Science	11:400:2xx, 3xx, 4xx	
Geography	01:450:2xx, 3xx, 4xx	Exceptions: 100, 102, 103, 205, 211, 222, 240, 262, 307, 309, 311, 320, 322, 330-338, 341, 342, 361, 363, 370, 380, 405, 406, 411, 413, 419, and 470.

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	Exceptions: 201, 211, 212, and 285.

3.8 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: Regarding basic programming courses, one needs to follow either ECE course sequence (332:252, 254, 351) or CS course sequence (198:111, 112, 213 or 214) as a group.

Some important notes:

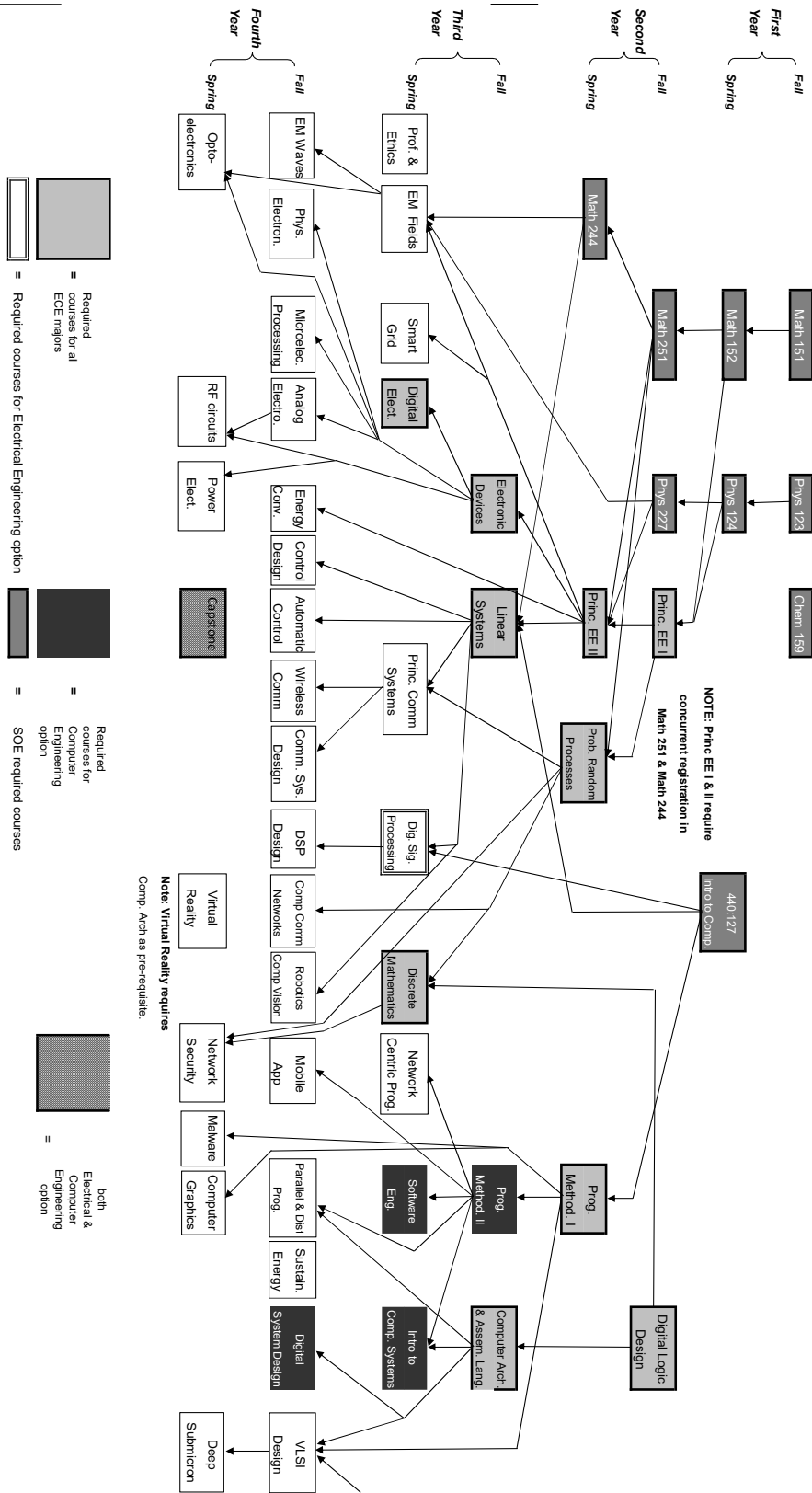
- 198:111 is based on Java while 332:252 (PM I) and its lab 254 are based on C++. The course 332:351 (PM II) introduces Java.
- Let us also emphasize that 198:111, 112 at Rutgers Camden are not equivalent to 198:111, 112 at New Brunswick; they are entirely different courses. The same applies to Rutgers Newark 198:101 and 198:102.
- Students who take the sequence 111, 112, and 213 (or 214) know more Java and less C (and related languages). On the other hand, students who take the sequence 252, 254, and 351 know more C++ and less Java. A student who successfully completes the three CS courses 198:111, 198:112, and 198:213 (or 198:214) is given credit for the courses 332:252, 332:254, and 332:351.
- A student who successfully completes only CS 111 should not proceed to take ECE 351 (PM II), he/she must take 198:111 and 198:112 before taking either 198:213/214 or 332:351. Then, he/she as mentioned above will get credit for 252, 254, and 351.
- Important: there is a residency requirement for ECE graduation and the CS courses will not count towards these 332:xxx credits requirements.

The following equivalences apply:

- **332:252** (Programming Methodology I): 198:112 (Data Structures)
- **332:254** (Programming Methodology I Lab): 198:111 (Introduction to Computer Science)
- **332:351** (Programming Methodology II): 198:213 (Software Methodology) or 198:214 (Systems Programming)
- **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)
- **14:332:331** (Computer Architecture and Assembly Language): 01:198:211 (Computer Architecture). Those who take 01:198:211 must still take the lab 14:332:333

3.9 Courses Prerequisite Chart

PRE-REQUISITE CHART FOR ECE UNDERGRADUATES



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
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
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	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	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	14:332:252	Programming Methodology I	14:440:127	14:332:254
Spring	14:332:254	Programming Methodology I Laboratory	14:440:127	14:332:252
Fall	14:332:301	Forces and Strategies that Shaped the Wireless Revolution	Junior standing	
Spring	14:332:312	Discrete Mathematics	14:332:226 and 14:332:231	
Spring	14:332:322	Principles of Communications Systems	14:332:226 and 14:332:345	
Fall; Summer	14:332:331	Computer Architecture and Assembly Language	14:332:231 and 14:332:233	14:332:333
Fall; Summer	14:332:333	Computer Architecture Laboratory	14:332:231 and 14:332:233	14:332:331

Fall; 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	14:332:347
Spring	14:332:346	Digital Signal Processing	14:332:345 and 14:440:127	14:332:348
Fall; Summer	14:332:347	Linear Systems and Signals Laboratory	14:332:222 and 14:332:224 and (01:640:244 or 01:640:252 or 01:640:292) and 14:440:127	14:332:345
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 and 14:332:254	
Fall	14:332:361	Electronic Devices	14:332:222 and 14:332:224	14:332:363
Fall	14:332:363	Electronic Devices Laboratory	14:332:222 and 14:332:224	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
Fall; Spring	14:332:373	Elements of Electrical Engineering	(01:640:251 or 01:640:291) and (01:750:227) ; Not open to electrical engineering students	01:640:244 and 14:332:375
Fall; Spring	14:332:375	Elements of Electrical Engineering Laboratory	Not open to electrical engineering students	14:332:373
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
	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	
Fall	14:332:411	Electrical Energy Conversion	14:332:222 or 50:750:234	
	14:332:415	Introduction to Automatic Control Theory	14:332:345	
	14:332:417	Control Systems Design	14:332:345	
	14:332:421	Wireless Communications	14:332:345	
	14:332:423	Computer and Communication Networks	(14:332:226 or 01:198:206 or 01:640:477)	

	14:332:424	Introduction to Information and Network Security	14:332:226 and 14:332:312	
	14:332:427	Communication Systems Design	14:332:322	
Spring	14:332:434	Introduction to Computer Systems	14:332:331 and 14:332:351	
Fall	14:332:435	Topics in ECE		
Spring	14:332:436	Topics in ECE		
fall	14:332:437	Digital Systems Design	14:332:351 and 14:332:331	
Fall	14:332:445	Topics in ECE		
Spring	14:332:446	Topics in ECE		
	14:332:447	Digital Signal Processing Design	14:332:346	
Spring	14:332:448	Capstone Design in ECE	Senior standing	
Fall	14:332:451	Introduction to Parallel and Distributed Programming	14:332:351 and 14:332:331	
Spring	14:332:452	Software Engineering	14:332:351	
Fall	14:332:453	Mobile App Engineering and User Experience	14:332:351	
Spring	14:332:456	Network Centric Programming	14:332:351	
Spring	14:332:460	Power Electronics	14:332:361	
Fall	14:332:461	Pulse Circuits	14:332:366	
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	
Spring	14:332:466	Optoelectronic Devices	14:332:361 and 14:332:382	
Fall	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	14:332:493	Topics in Electrical and Computer Engineering		
Spring	14:332:494	Topics in Electrical and Computer Engineering		
Spring	14:332:496	Co-op Internship in Electrical and Computer Engineering	Permission of department. Grade Pass/No Credit	
Fall	14:332:497	Co-op Internship in Electrical and Computer Engineering	Permission of department. Grade Pass/No Credit	

4. General Information

4.1 **Pass/No Credit Courses:**

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.

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.

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.

5. 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: UNDERGRADUATE)

ECE Undergraduate Director: Dr. Hana Godrich (godrich@soe.rutgers.edu) 848-445-2606