

# RUTGERS

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## **Handbook for Undergraduate Students in Electrical and Computer Engineering**

This handbook can be found at  
[http://www.ece.rutgers.edu/contact\\_and\\_general\\_information](http://www.ece.rutgers.edu/contact_and_general_information)

A lot of other information regarding the undergraduate program  
can also be found at  
<http://www.ece.rutgers.edu>  
under 'UNDERGRADUATE'.

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DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

HANDBOOK FOR UNDERGRADUATE STUDENT

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# Educational Objectives, Outcomes, and Assessment Process

## 1. Degree Title

Bachelor of Science in Electrical and Computer Engineering (BSECE)

## 2. 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.

## 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 in order 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 at least one of 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.

## 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.

#### 4. 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	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 Princ. of Comm. 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
418 Cap. Des. - Systems & DSP	H	H	H	H	H	S	H	S	H	S	H	H	H	N	N	H	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
428 Cap. Des.- Comm. Systems	H	H	H	H	H	S	H	S	H	S	H	H	H	S	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
438 Cap. Des. - Comp. Systems	H	H	H	H	H	S	H	S	H	S	H	N	N	H	H	H	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
461 Pulse Circuits	H	S	N	S	H	N	S	N	S	N	H	H	S	S	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
468 Cap. Des. - Electronics	H	H	H	H	H	S	H	S	H	S	H	H	H	N	N	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						

<b>Outcomes</b>
(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
<b>Others</b>
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

## 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 particular 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 a lot of 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 option and (2) Computer Engineering option. **Both options lead to the same B.S. Degree in Electrical and Computer Engineering.** 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.

### **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 particular 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.

### **Electives:**

#### *For the Electrical Engineering Option:*

Electives consists of (1) **four** courses of electrical electives, (2) **two** courses of technical electives, (3) **one** course of a capstone design elective, (4) **one** course of Science Math and Engineering elective, (5) **two** courses of lower level Hum/Soc electives, (6) **two** courses of upper level Hum/Soc electives, and (7) **one** course of a general elective.

#### *For the 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, (4) **one** course of a capstone design elective, (5) **one** course of Science Math and Engineering elective, (6) **two** lower level Hum/Soc electives, and (7) **two** upper level Hum/Soc electives.

Please note that \*Independent Study/Special Problems, 14:332:491 and 14:32:492, may be taken as either electrical or technical electives for the Electrical Engineering option, or as computer electives or technical electives for the Computer Engineering option, 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 total of 6 credits (two courses) of Independent Study/Special Problems can be taken for elective credit. 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.

**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. A list of electives is given later on.

### **Humanities/Social Science Electives:**

The course 01:220:102 Introduction to Microeconomics is required.

Besides this, both the Electrical and Computer Engineering options require a total of 12 credits of humanities/social science electives.

For a description and list of acceptable humanities/social science electives, please refer to the website:

<http://soe.rutgers.edu/oa/electives> or

[http://soe.rutgers.edu/sites/default/files/imce/pdfs/humanities\\_list.pdf](http://soe.rutgers.edu/sites/default/files/imce/pdfs/humanities_list.pdf).

A lot of advising material is available at <http://soe.rutgers.edu/oa>.

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.

### **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. Consult with the Associate Dean for Academic Affairs regarding these exceptions. 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.

### **\*Co-Op Internship:**

The Department of Electrical and Computer Engineering allows a student to earn six academic credits on a Pass/No credit basis. **Upon successful completion, three of these credits can be used in place of an electrical or a computer elective and another three credits in place of 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.

### **Five-Year B.S./M.B.A. Program:**

A special joint program offered by the School of Engineering and the Graduate School of Management-Newark is available for qualified engineering students. This program offers the opportunity to obtain the Master of Business Administration degree within one calendar year of completing the baccalaureate degree requirements. An interested student should review the Graduate School of Management-Newark

website for the MBA Program. An application to the Graduate School of Management-Newark should be filed in the fall term of the junior year. After applying, the student can consult with the Associate Dean of Engineering (848-445-2212) if he/she has questions.

### **Five-Year Dual-Degree Program:**

Students in the five-year dual-degree program (333 curriculum) must satisfy all of the above requirements (332 curriculum) in addition to the requirements of their second major.

### **Prerequisites for Courses Offered by the Department of Computer Science:**

Most of the Computer Science courses, can be taken whenever you have completed the prerequisites of 332:312-Discrete Mathematics, 332:231- Digital Logic Design, 332:252-Programming Methodology I, and 332:331 Computer Architecture. No other Computer Science prerequisites are necessary.

### **Equivalency of CS and ECE Courses:**

Regarding basic programming courses, one needs to follow either ECE course sequence (332:252, 254, 351) as a group or CS course sequence (198:111, 112, 213 or 214) as a group. One cannot jump from one group to the other without losing credit towards graduation.

Let us first observe some **Background Info:**

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 three CS courses 111, 112, and 213 (or 214) **together as a group** are equivalent to ECE 252, 254 (Lab), and 351 **as a group**. 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 111, 112, and 213 (or 214) is given credit for the courses 252, 254, and 351, however he/she must take an extra ECE elective (**332:---**) to earn proper number of ECE credits for graduation. EXTRA elective means that it is beyond the other elective requirements in the curriculum.

A student who successfully completes only CS 111 should not proceed to take ECE 351 (PM II), he/she must take CS 112 and 213 (or 214). Then, he/she as mentioned above will get credit for 252, 254, and 351; however he/she must take an extra ECE elective (**332:---**). That is, ECE students will not be given credit for 111 alone towards 252 and the lab 254, and he/she must take 112 and 213 (or 214) as well.

**01:198:205 and 14:332:312 are both courses on Discrete Math.**

We do not encourage you to take 01:198:205 in place of 14:332:312.

Although we do not encourage you to do so, if you choose to take 01:198:205, credit can be given to 14:332:312; however you must take an extra ECE elective (332:---). EXTRA elective means that it is beyond the other elective requirements in the curriculum.

**01:640:300 and 14:332:312 (or 198:205) have several common topics.** Credit cannot be given to both 640:300 and 332:312 (or 198:205). Although we do not encourage you to do so, if you choose to take 01:640:300, credit can be given to 14:332:312, however you must take an extra ECE elective (**332:---**). EXTRA elective means that it is beyond the other elective requirements in the curriculum.

**01:198:206 and 14:332:226 are both courses on Probability, Random Variables and Random Processes.** A student who takes 01:198:206 can be exempted taking 14:332:226, however he/she must take an extra ECE elective (**332:---**). EXTRA elective means that it is beyond the other elective requirements in the curriculum.

**01:198:211 and 14:332:331 are both Computer Architecture courses.**

We do not encourage you to take 01:198:211 in place of 14:332:331. Consult the UG Director if you have a valid reason such as 'Double Majoring both in ECE and CS'. If you are just doing minor in CS, you should take **14:332:331**. **Those who take 01:198:211 with a reason must still take the lab 14:332:333.**

**01:198:431 and 14:332:452 are both Software Engineering courses.**

A student who takes 01:198:431 is exempted taking 14:332:452, however he/she must take an extra ECE elective (**332:---**). EXTRA elective means that it is beyond the other elective requirements in the curriculum.

### **Minoring in CS:**

Look at the CS website for the requirements.

**A suggested choice for Computer Option Students enabling a CS minor is as follows:** The choice given below assume that CS dept does not give credit towards minor for the ECE courses 332:252, 254, 312, 331 and 351. Students should check with CS departmental advisor before finalizing their schedules. Also, the suggested choice requires a careful planning of taking senior ECE electives in order to meet the prerequisites so that a **capstone design course** can be taken among the allowed ECE capstone design courses

**Computer Option Students:** Take 198:111, 112, 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 198: 336, 344, 417, 424, 440, and 476. Substitute 198:111, 112, 214 for ECE required courses 332:252, 254 and 351 (PM I and PM II). This substitution requires **an additional ECE elective (332:---**) in order to fulfill ECE credit requirements. You may take a CS course as Science Math Engineering elective.

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

**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 dept 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.

**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 some thing about how an automobile works will enhance the use of it. On the other hand an engineer designing an automobile has to 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.

On the other hand, 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.

**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.

### **\*Pass/No Credit Courses:**

An engineering student may take one elective course (not exceeding 4 credits) on a *Pass/No Credit* basis in any two terms of the curriculum. None of the required courses in either the Electrical Engineering or Computer Engineering options can be taken on a *Pass/No Credit* basis. None of the technically oriented electives in either the Electrical Engineering or Computer Engineering options can be taken on a *Pass/No Credit* basis. An application to enroll in courses for *Pass/No Credit* must be filled out by the student and submitted to the Associate Dean of Academic Affairs. For a description, details and forms, please refer to the website: <http://coewww.rutgers.edu/oa/gpa.php>

**Course Substitutions:** Absolutely no substitutions are allowed for any required 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.

### **\*Transfer Credits:**

Certain courses can be taken at other universities and the credits can be transferred to Rutgers. 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. An application must be filled out and approved by the Undergraduate Director before a course is taken elsewhere.

### **\*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.

### **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.

### **Prerequisite Chart:**

To review the suggested schedule of courses with the required prerequisites for each course, please see the prerequisite chart (see the last page).

### **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 (Dean Bernath), 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.

### **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.

### **Academic Standing:**

**Probation:** Student grades are reviewed each semester. Students whose grades fall below a certain level, depending upon the number of semesters enrolled at Rutgers, will be placed on probation. **DO NOT TAKE PROBATION LIGHTLY.**

**Dismissal:** A student placed on probation twice during his/her engineering career at Rutgers and who shows no improvement or only marginal improvement has little chance of completing his/her program in ECE. Note that the two semesters on probation do not have to be consecutive. For example, if you have been placed on probation in any two earlier semesters and you are about to be placed on probation for a third time, the ECE department will seriously consider dropping you from the ECE curriculum. For a complete description of probation, dismissal, etc., please refer to the website: **[http://soe.rutgers.edu/oaa/scholastic\\_standing](http://soe.rutgers.edu/oaa/scholastic_standing)**. In addition, a student may be dismissed if his/her term grade point average drops below a certain level, irrespective of whether the student had been on probation earlier or not.

### **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.

**Curricula of Electrical and Computer options** are given on the following pages. Curricula visuals which display all the course requirements are given shortly.

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

## **Contact Information:**

**SOE Academic Dean's Office:**

<http://coewww.rutgers.edu/oa/> 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:**

**Prof. Hana Godrich (godrich@rci.rutgers.edu) 848-445-9132**

\*Forms for Independent Study/Special Problems, Co-Op Internship, Pass/No credit, transfer credits, and graduate course enrollment are at <http://www.ece.rutgers.edu/undergrad-forms>.

### **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>	<b>Introduction to Microeconomics</b>	3
01:750:123	Analytical Physics IA	2			
<u>      :      :      </u>	<b>Hum/Soc elective</b>	3			
<u>Total Credits</u>		17	<u>Total Credits</u>		15

#### **Sophomore Year**

14:332:221	Principles of Electrical Engg. I	M 3	14:332:222	Principles of Electrical Engg. 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 Engg/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>	<b>Hum/Soc elective</b>	3	14:332:_____	<b>Electrical elective</b>	M 3
			<u>      :      :      </u>	<b>Technical elective</b>	M 3
<u>Total Credits</u>		15	<u>Total Credits</u>		18

#### **Senior Year**

14:332:_____	<b>Electrical elective</b>	M 3	14:332:_____	<b>Capstone Design elective</b>	M 3
14:332:_____	<b>Electrical elective</b>	M 3	14:332:_____	<b>Electrical elective</b>	M 3
<u>      :      :      </u>	<b>Science Math Engg elective</b>	M 3	<u>      :      :      </u>	<b>General elective</b>	3
<u>      :      :      </u>	<b>Technical elective</b>	M 3	<u>      :      :      </u>	<b>Hum/Soc elective</b>	3*

\_\_\_\_\_ Hum/Soc elective 3\*

Total Credits

15

Total Credits

12

**Total degree credits 123**

Electives consists of (1) four courses of electrical electives, (2) two courses of Technical electives, (3) one course of Capstone design elective, (4) one course of Science Math Eng'g elective, (5) two courses of lower level Hum/Soc electives, (6) two courses of upper level Hum/Sci electives denoted by \* (not all four humanity electives can be in the same subject), and (7) one course of general elective. 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, 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.**

## 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>	<b>Introduction to Microeconomics</b>	3
01:750:123	Analytical Physics IA	2			
<u>      :</u>	<b>Hum/Soc elective</b>	3			
<u>      :</u>					
<u>Total Credits</u>		17	<u>Total Credits</u>		15

### Sophomore Year

14:332:221	Principles of Electrical Engg. I	M 3	14:332:222	Principles of Electrical Engg. 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 Engg/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>	<b>Computer/Tech elective</b>	M 3
<u>Total Credits</u>		15	<u>Total Credits</u>		17

### Senior Year

14:332:437	Digital System Design	M 3	14:332:___	<b>Capstone Design elective</b>	M 3
<u>      :</u>	<b>Computer elective</b>	M 3	<u>      :</u>	<b>Computer elective</b>	M 3
<u>      :</u>	<b>Tech elective</b>	M 3	<u>      :</u>	<b>Hum/Soc elective</b>	3*
<u>      :</u>	<b>Science Math Engg elective</b>	M 3	<u>      :</u>	<b>Hum/Soc elective</b>	3*
<u>      :</u>	<b>Hum/Soc elective</b>	3			
<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 capstone design elective, (5) one course of Science Math Eng'g elective, (6) two lower level Hum/Soc electives, and (7) 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.

## List of Electives for the Electrical Engineering Option

### NOTES:

1. ONE **Capstone Design Elective** is required.
2. Any FOUR **Electrical Electives** are to be selected from **List 1** below..
3. Any TWO **Technical Electives** are to be selected from either **List 1** or **List 2** below.
4. One **Science Math and Engineering elective (any Science, Math, or Eng'g course above 200 level)**
5. Each 4-credit Computer Science (Livingston College) course constitutes one elective course.
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 Dean Bernath.

The details of **CAPSTONE DESIGN ELECTIVES** are explained in later pages.

### **LIST 1: ELECTRICAL ELECTIVES**

14:332:322	Principles of Communication Systems
14:332:351	Programming Methodology II
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
14:332:491	Special Problems/Independent Study (not open to students on academic probation)
14:332:492	Special Problems/Independent Study (not open to students on academic probation)
14:332:493	Topics in Electrical and Computer Engineering
14:332:494	Topics in Electrical and Computer Engineering

## LIST 2: TECHNICAL ELECTIVES

01:160:307-308	A two semester sequence in <u>Organic Chemistry</u> can be used as <u>two</u> technical electives by a student who has completed General Biology and has a
<b>OR</b>	
cumulative	
01:160:315-316	average above 3.00.

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

14:540:343	Engineering Economics
<b>OR</b>	
14:540:461	Engineering Law

14:540:410 Linear Programming  
14:540:487 Energy Systems Modeling and Optimization

14:635:316 Electronic Optical and Magnetic Properties of Materials  
14:635:405 Solar Cell Design and Processing

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 duplicates 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

14:650:351\*\* Thermodynamics  
14:650:474 Alternative Energy Systems (Credit cannot be given for both 332:402 and 650:474)  
14:650:481 Heat Transfer

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

**Science Math and Engineering Elective:** A list is given in about 2 or 3 pages later.

\* 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

**NOTE: Independent Study or Special Problems xxx:491, xxx:492**, where “xxx” is a departmental code other than 332, are not, in general, considered as electives.

## List of Electives for the Computer Engineering Option

### NOTES:

1. ONE Capstone Design Elective is required.
2. Any TWO Computer Electives are to be selected from List 1 below.
3. Any One Elective is to be selected from either List 1 or List 2 below.
4. Any One Elective is to be selected from either List 2 below.
5. One Science Math or Engineering elective (any science, Math, or Eng'g course above 200 level)
6. Each 4-credit Computer Science (Livingston College) course constitutes one elective course.
7. 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 Dean Bernath.

The details of CAPSTONE DESIGN ELECTIVES are explained in later pages.

### LIST 1: COMPUTER ELECTIVES

- 14:332:376 Virtual Reality (14:332:378 is a corequisite)  
14:332:382 Electromagnetic Fields  
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  
14:332:451 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 Special Problems/Independent Study (not open to students on academic probation)  
14:332:492 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

### LIST 2: TECHNICAL ELECTIVES

- 14:332:322 Principles of Communication Systems  
14:332:346 Digital Signal Processing  
14:332:402 Sustainable Energy: choosing among options  
14:332:415 Introduction to Automatic Control Theory (This course is not offered often)  
14:332:447 Introduction to Digital Signal Processing Design  
14:332:463 Analog Electronics  
14:332:465 Physical Electronics  
14:332:466 Opto-Electronic Devices  
14:332:481 Electromagnetic Waves
- 01:640:250 Introductory Linear Algebra  
01:640:350 Linear Algebra

01:198:323 Numerical Analysis and Computing  
01:198:417 Distributed Systems: Concepts and Design  
01:198:424 Modeling and Simulation of Continuous Systems  
01:198:440 Introduction to Artificial Intelligence  
01:198:476 Advanced Web Applications: Design and Implementation

14:540:343 Engineering Economics

**OR**

14:540:461 Engineering Law

01:160:307-308 A two semester sequence in Organic Chemistry can be used as two technical  
**OR** electives by a student who has completed General Biology and has a cumulative  
01:160:315-316 average above 3.00.

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**NOTE: Independent Study or Special Problems xxx:491, xxx:492**, where “xxx” is a departmental code other than 332, are not, in general, considered as electives.

## Science, Math, and Engineering Electives – List

**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:

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: 14:xxx:2xxx, 3xxx, 4xxx (except 14:332:301)

Environmental Science: 11:375:2xx, 3xx, 4xx

Food Science: 11:400:2xx, 3xx, 4xx

Geography: 01:4502xx, 3xx, 4xx,

except 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, except 201, 211, 212, and 285.

## Capstone Design Tracks

Capstone design courses are undergoing modifications and revisions. In general, a student can do a valid capstone design project initiated by him/her and approved by the undergraduate director as long as the project pertains to Electrical and Computer Engineering. In such a case, no traditional pre-requisite courses are necessary, however the student needs to justify before beginning the project work that he/she is capable of carrying out the proposed project.

Several possible capstone design tracks, which are normally offered, are outlined below. However, some other tracks are possible on ad hoc basis depending on our faculty interests in opening up new and emerging areas in Electrical and Computer Engineering.

### Guidance for Electrical Engineering Option with a focus in Electronics

There are several possible tracks in the area of Electronics. Three possible tracks are illustrated below. For each track, the required and advisable elective courses are given below. For some elective locations, whenever no course is specified, one can freely select them from the list of electives given in the handbook. Course offerings as given below are most often followed, however, exceptions can arise. Some courses might be switched from Fall to Spring and vice versa.

#### Electromagnetics and optoelectronics:

- 14:332:382 Electromagnetic Fields (Required course, Spring Semester of Junior year)
- :---:---- Technical Elective (Spring Semester of Junior year)
- 14:332:466 Optoelectronics (Required course, Fall Semester of Senior year)
- 14:332:481 Electromagnetic Waves (Required course, Fall Semester of Senior year)
- 14:332:465 Physical Electronics (Required course, Fall Semester of Senior year)
- 14:332:463 Analog Electronics (Advisable, Fall Semester of senior year)
- 14:332:468 Capstone Design - Electronics (Required course, Spring Semester of Senior year)

#### Electronic Circuits:

- 14:332:460 Power Electronics (Advisable, Spring Semester of Junior year)
- :---:---- Technical Elective (Spring Semester of Junior year)
- 14:332:---- Electrical Elective (Fall Semester of Senior year)
- 14:332:463 Analog Electronics (Required course, Fall Semester of Senior year)
- 14:332:465 Physical Electronics (Required course, Fall Semester of Senior year)
- 14:332:468 Capstone Design - Electronics (Required course, Spring Semester of Senior year)
- 14:332:---- Electrical Elective (Spring Semester of Senior year)

#### Microelectronic Processing:

- 14:332:460 Power Electronics (Advisable, Spring Semester of Junior year)
- :---:---- Technical Elective (Spring Semester of Junior year)
- 14:332:463 Analog Electronics (Advisable, Fall Semester of senior year)
- 14:332:465 Physical Electronics (Required course, Fall Semester of Senior year)
- 14:332:467 Intro to Microelectronic Processing (Required course, Fall Semester of Senior year)
- 14:332:468 Capstone Design - Electronics (Required course, Spring Semester of Senior year)
- 14:332:---- Electrical Elective (Spring Semester of Senior year)

## **Guidance for Electrical Engineering Option with a focus in Communications**

There are two possible tracks in the area of communications. For each track, the required and advisable elective courses are given below. For some elective locations, whenever no course is specified, one can freely select them from the list of electives given in the handbook.

### **Communication Systems - Hardware:**

14:332:322 Principles of communication systems (Required course, Spring Semester of Junior year)

01:640:250 Intro to Linear Algebra (highly advisable technical elective, Spring Semester of Junior year)

14:332:421 Wireless Communication Systems (Highly Advisable, Fall Semester of senior year)

14:332:427 Communication System Design (Required course, Fall Semester of senior year)

14:332:423 Computer and Communication Networks  
(Advisable, Fall Semester of senior year, Take it in place of Technical Elective or Science Math and Eng'g elective)

14:332:428 Capstone Design - Communication Systems (Required course, Spring Semester of senior year)

14:332:424 Intro to Information and Network Security (Advisable, Spring Semester of senior year)

### **Wireless Communication Systems:**

14:332:322 Principles of communication systems (Required course, Spring Semester of Junior year)

01:640:250 Intro to Linear Algebra (highly advisable technical elective, Spring Semester of Junior year)

14:332:421 Wireless Communication Systems (Required course, Fall Semester of Senior year)

14:332:427 Communication System Design (Highly Advisable, Fall Semester of Senior year)

14:332:423 Computer and Communication Networks  
(Advisable, Fall Semester of Senior year, Take it in place of Technical Elective or Science Math and Eng'g elective)

14:332:428 Capstone Design - Communication Systems (Required course, Spring Semester of Senior year)

14:332:424 Intro to Information and Network Security (Advisable, Spring Semester of Senior year)

## **Guidance for Electrical Engineering Option with a focus in Control and DSP**

There are two possible tracks in the area of Systems and Digital Signal Processing. For each track, the required and advisable elective courses are given below. For some elective locations, whenever no course is specified, one can freely select them from the list of electives given in the handbook.

### **Automatic Control:**

14:332:346 Digital Signal Processing (This is a standard required course in Electrical Option)  
14:332:---- Electrical Elective (Spring Semester of Junior year)  
01:640:250 Intro to Linear Algebra (highly advisable technical elective, Spring Semester of Junior year)  
14:332:415 Intro to Automatic Control (Fall Semester of Senior year, This course is not offered often, if not offered, take an EE elective)  
14:332:417 Control System Design (Required course, Fall Semester of Senior year)  
14:332:463 Analog Electronics (Advisable, Fall Semester of Senior year)  
14:332:418 Capstone Design - Systems and Digital Signal Processing (Required course, Spring Semester of Senior year)  
14:332:---- Electrical Elective (Spring Semester of Senior year)

### **Digital Signal Processing:**

14:332:346 Digital Signal Processing (This is a standard required course in Electrical Option)  
14:332:---- Electrical Elective (Spring Semester of Junior year)  
01:640:250 Intro to Linear Algebra (highly advisable technical elective, Spring Semester of Junior year)  
14:332:447 Digital Signal Processing Design (Required course, Fall Semester of Senior year)  
14:332:463 Analog Electronics (Advisable, Fall Semester of Senior year)  
---:---:---- Technical Elective (Fall Semester of Senior year)  
14:332:418 Capstone Design - Systems and Digital Signal Processing (Required course, Spring Semester of Senior year)  
14:332:---- Electrical Elective (Spring Semester of Senior year)

## **Guidance for Electrical Engineering Option with a focus in VLSI DESIGN**

**One can do a capstone design project in VLSI Design following Computer Engineering option as well (See for details discussed in Computer Engineering option).**

### **VLSI Design:**

14:332:---- Power Electronics (Advisable, Spring Semester of Junior year)  
--:---:----- Technical Elective (Spring Semester of Junior year)  
14:332:465 Physical Electronics (Advisable, Fall Semester of Senior year)  
14:332:467 Microelectronic Processing  
(Advisable, Fall Semester of Senior year, Take it in place of Technical Elective)  
14:332:479 VLSI Design (Required course, Fall Semester of Senior year)  
14:332:438 Capstone Design - Computers (Required course, Spring Semester of Senior year)  
14:332:482 Deep Submicron VLSI Design  
(Highly advisable electrical elective, Spring Semester of Senior year)

### **VLSI Design and Microelectronic Processing:**

Those students interested in coupling Microelectronic Processing with VLSI Design can follow the schedule given below:

14:332:---- Power Electronics (Advisable, Spring Semester of Junior year)  
--:---:----- Technical Elective (Spring Semester of Junior year)  
14:332:465 Physical Electronics (Required course, Fall Semester of Senior year)  
14:332:467 Microelectronic Processing (Required, Fall Semester of Senior year)  
(Take it in place of Technical Elective)  
14:332:479 VLSI Design (Required course, Fall Semester of Senior year)  
14:332:438 Capstone Design - Computers (Required course, Spring Semester of Senior year)  
14:332:468 Capstone Design - Electronics (Required course, Spring Semester of Senior year)  
14:332:482 Deep Submicron VLSI Design (highly advisable electrical elective, Spring Semester of Senior year, take it in place of Science Math and Eng'g elective)

Note that in this track, students would do two capstone design projects one in Computers (VLSI Design) and the other in Electronics (Microelectronic Processing).

## **Guidance for Electrical Engineering Option with a focus in Robotics and Computer Vision**

**One can do a capstone design project in Robotics and Computer Vision following Computer Engineering option as well (See for details discussed in Computer Engineering option).**

### **Robotics and Computer Vision:**

14:332:346 Digital Signal Processing (This is a standard required course in Electrical Option)

14:332:---- Electrical Elective (Spring Semester of Junior year)

01:640:250 Intro to Linear Algebra (highly advisable technical elective, Spring Semester of Junior year)

14:332:472 Intro to Robotics and Computer Vision (Required course, Fall Semester of Senior year)

14:332:---- Electrical Elective (Fall Semester of Senior year)

--:--:---- Technical Elective (Fall Semester of Senior year)

14:332:438 Capstone Design - Computers (Required course, Spring Semester of Senior year)

14:332:---- Electrical Elective (Spring Semester of Senior year)

### **Capstone Design in Virtual Reality:**

14:332:376 Virtual Reality (Required course, Spring Semester of Junior year)

14:332:378 Virtual Reality Lab (Required course, Spring Semester of Junior year)

14:332:478 Capstone Design - Virtual Reality (Required course, Spring Semester of Senior year)

Other elective courses to satisfy degree requirements.

## Guidance for Computer Engineering Option

Besides Capstone Design in Virtual Reality, there are four possible tracks in the area of Computer Engineering. For each track, the required and advisable elective courses are given below. For some elective locations, whenever no course is specified, one can freely select them from the list of electives given in the handbook.

### Software and Systems:

14:332:452 Software Engineering (This is a standard required course in Computer Option)

14:332:456 Network-Centric Programming

(Highly advisable computer/Tech elective if offered, Spring Semester of Junior year, if not offered take a Computer elective)

14:332:451 Intro to Parallel and Distributed Programming

(Required computer elective, Fall Semester of Senior year)

---:---:----- Tech Elective (Fall Semester of Senior year)

14:332:438 Capstone Design - Computers (Required course, Spring Semester of Senior year)

---:---:----- Computer/Technical Elective (Spring Semester of Senior year)

### Digital System Design:

---:---:----- Computer/Tech Elective (Spring Semester of Junior year)

14:332:437 Digital System Design (This is a standard required course in Computer Option)

---:---:----- Computer Elective (Fall Semester of Senior year)

---:---:----- Tech Elective (Fall Semester of Senior year)

14:332:438 Capstone Design - Computers (Required course, Spring Semester of Senior year)

---:---:----- Computer Elective (Spring Semester of Senior year)

### VLSI Design:

**One can do a capstone design project in VLSI Design following Electrical Engineering option as well (See for details discussed in Electrical Engineering option).**

---:---:----- Computer/Tech Elective (Spring Semester of Junior year)

14:332:479 Intro to VLSI Design (Required course, Fall Semester of Senior year)

---:---:----- Tech Elective (Fall Semester of Senior year)

14:332:438 Capstone Design - Computers (Required course, Spring Semester of Senior year)

14:332:482 Deep Submicron VLSI Design (Highly advisable computer elective, Spring Semester of Senior year)

### Robotics and Computer Vision:

**One can do a capstone design project in Robotics and Computer Vision following Electrical Engineering option as well (See for details discussed in Electrical Engineering option).**

01:640:250 Intro to Linear Algebra (highly advisable technical elective, Spring Semester of Senior year)

14:332:472 Intro to Robotics and Computer Vision (Required course, Fall Semester of Senior year)

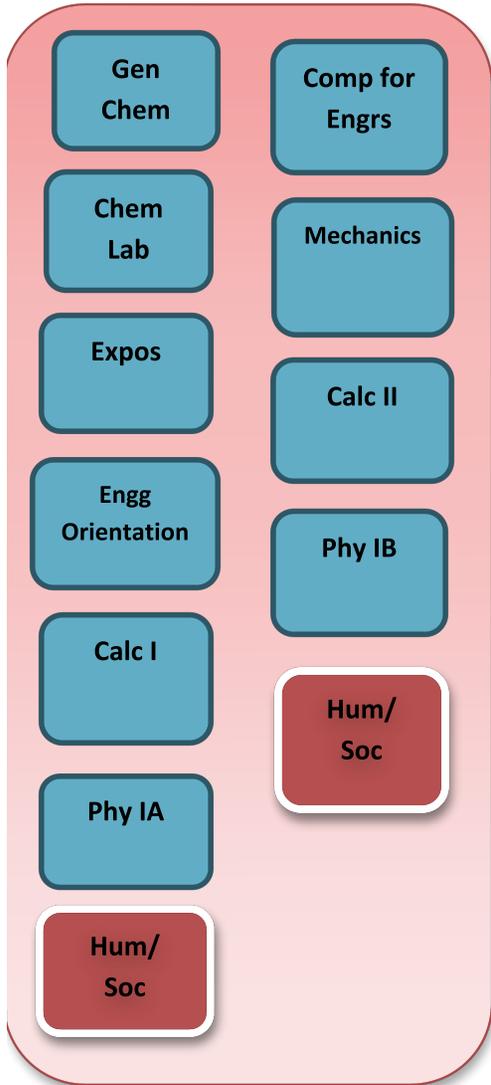
---:---:----- Computer Elective (Fall Semester of Senior year)

14:332:438 Capstone Design - Computers (Required course, Spring Semester of Senior year)

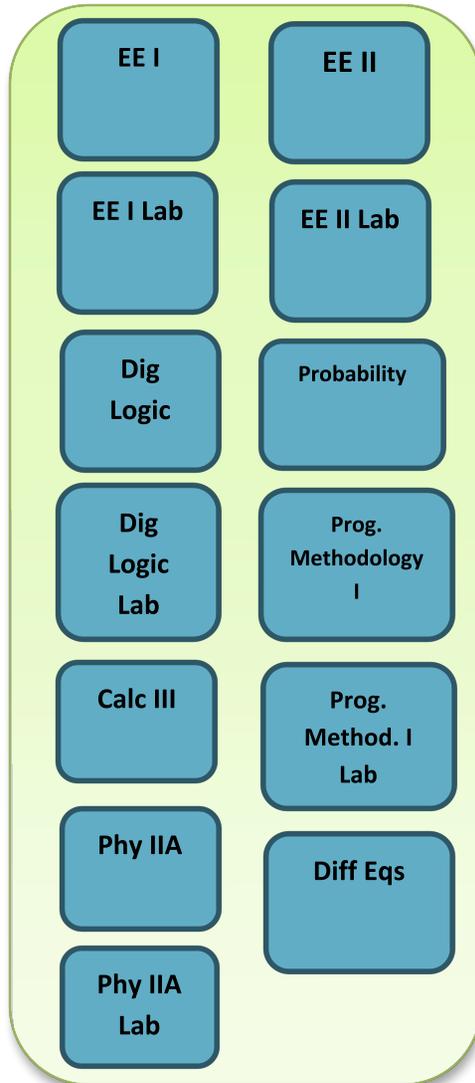
---:---:----- Computer Elective (Spring Semester of Senior year)

# Four Years to Your CE Degree

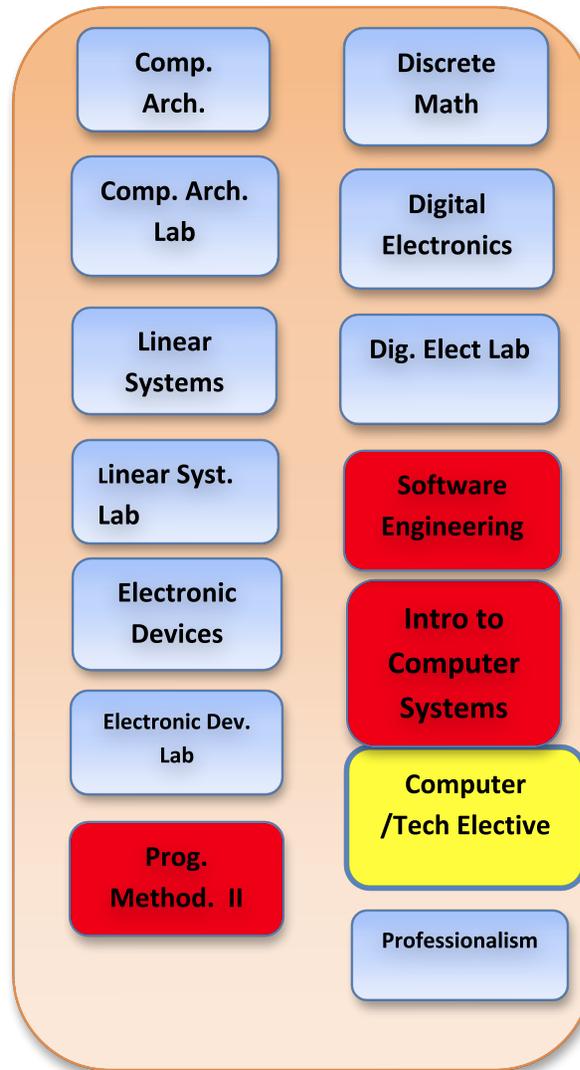
## Year 1: The Foundation



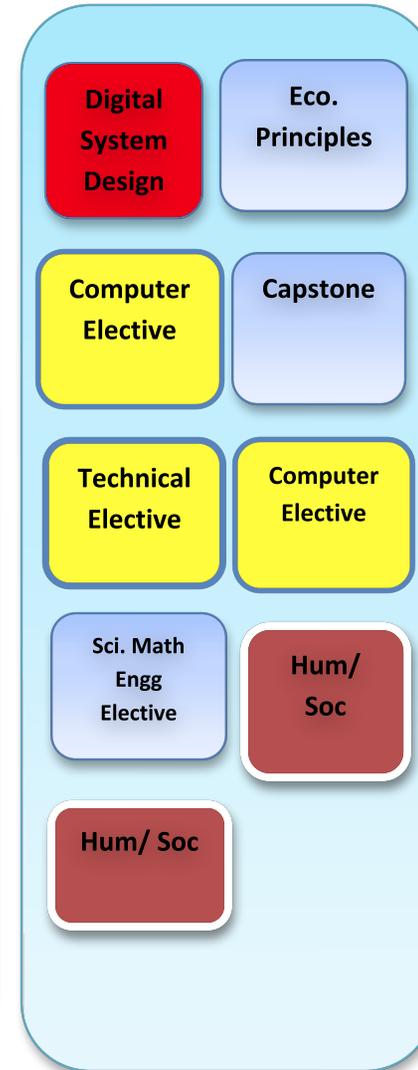
## Year 2: Intro to EE



## Year 3: Define Your Area



## Year 4: Plan Your Career



REQUIRED FOR ALL PROGRAMS

HUMANITIES/ SOCIAL SCIENCES

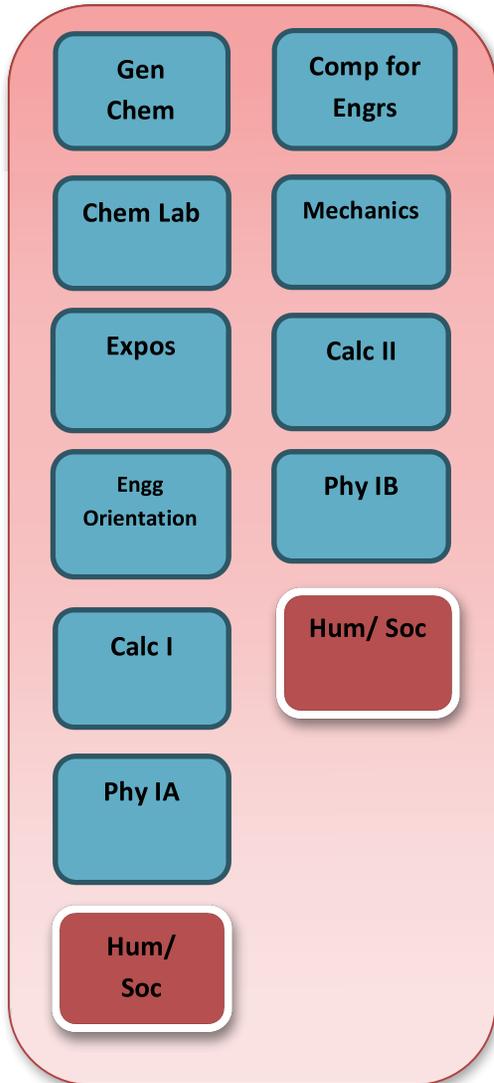
Both: EE/ CE COURSES

CE COURSES

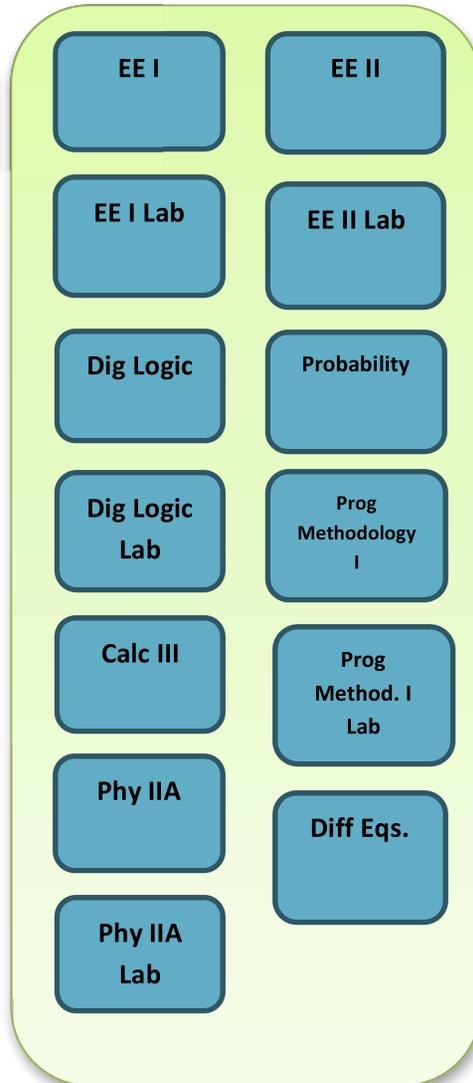
CHOICE OF ECE AND OTHER COURSES

# Four Years to Your EE Degree

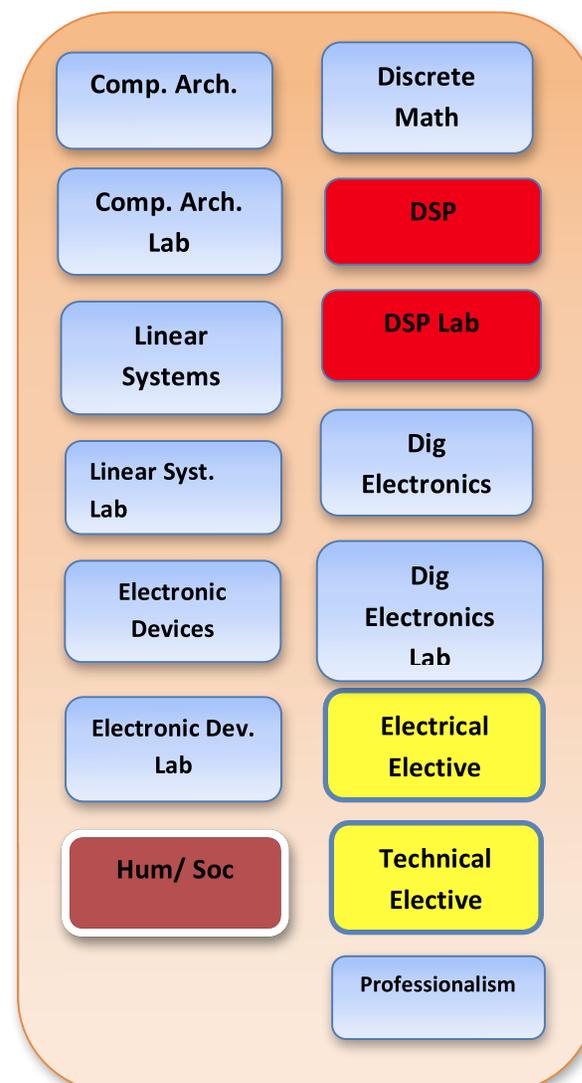
## Year 1: The Foundation



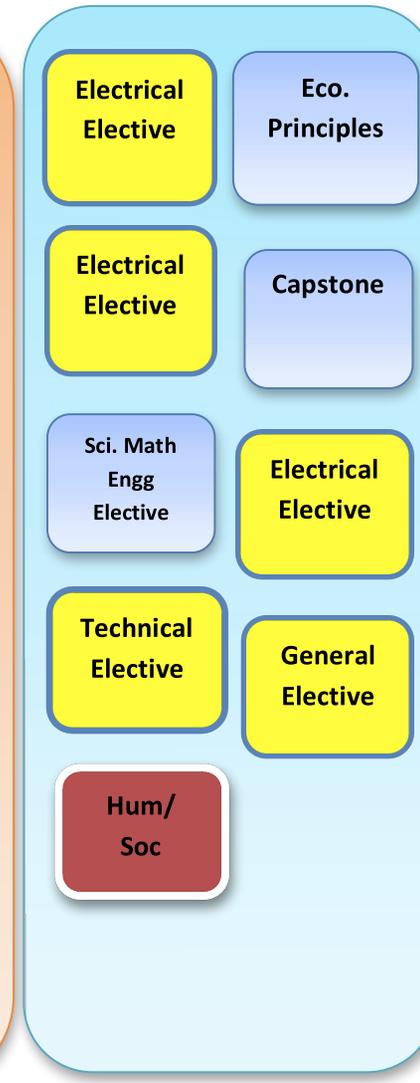
## Year 2: Intro to EE



## Year 3: Define Your Area



## Year 4: Plan Your Career



REQUIRED FOR ALL PROGRAMS

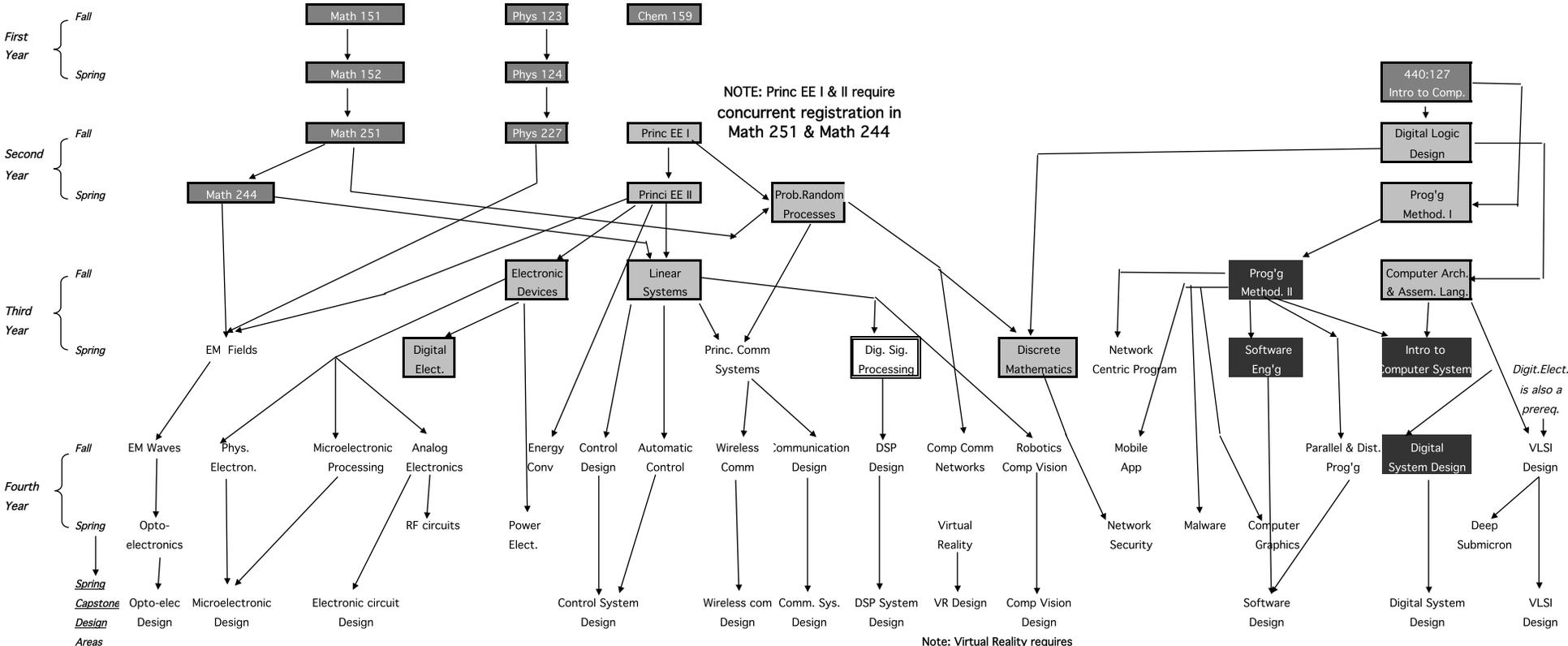
HUMANITIES/ SOCIAL SCIENCES

Both: EE/ CE COURSES

EE COURSES

CHOICE OF ECE AND OTHER

# PRE-REQUISITE CHART FOR ECE UNDERGRADUATES



NOTE: Princ EE I & II require concurrent registration in Math 251 & Math 244

Note: Virtual Reality requires Comp. Arch as pre-requisite.

*Digit. Elect. is also a prereq.*