

# Electrical Engineering (BS): Renewable Electric Energy Systems Concentration

To see more about what you will learn in this program, visit the Learning Outcomes website (<https://apps.oirp.ncsu.edu/pgas/>)!

## Core Courses

The electrical and computer engineering curricula share core courses comprising a substantial portion of the first three years of study. Many of the core courses are offered three times a year in fall, spring, and summer. A strong emphasis is placed on fundamental concepts in core courses so that graduates are prepared for rapid technological changes common in the electrical and computer engineering professions. A comprehensive foundation in mathematics and the physical sciences in the freshman year is followed in subsequent years by additional core courses in mathematics, physics, electric circuit theory, digital logic, computer systems, electronics, electromagnetics, and linear systems. Laboratory work is designed to demonstrate fundamental principles and to provide experience in designing and testing electronic hardware and computer software. Both curricula have a required two semester senior design project which gives students comprehensive experience in designing, building, and testing physical systems.

## Curricula

In addition to the core courses described above, students in the electrical engineering curriculum take two foundational electives and four specialization electives in areas of their choice within the discipline and two technical electives that can be in either electrical engineering or selected engineering courses offered by other departments. Beyond the core, students in the computer engineering curriculum take courses in discrete mathematics, data structures, embedded systems, and complex digital systems, in addition to four specialization electives in areas of their choice and one technical elective. For both curricula, a variety of elective courses are offered in communications, computational intelligence, controls, digital signal processing, digital systems, nanotechnology, mechatronics, microelectronics, networking, robotics, and VLSI design. There are typically a dozen or more of these courses offered each fall and spring semester and two or three available each summer.

## Plan Requirements

### First Year

Fall Semester		Hours
CH 101	Chemistry - A Molecular Science <sup>1</sup>	3
CH 102	General Chemistry Laboratory <sup>1</sup>	1
E 101	Introduction to Engineering & Problem Solving <sup>2</sup>	1
E 115	Introduction to Computing Environments	1
ENG 101	Academic Writing and Research <sup>2</sup>	4
MA 141	Calculus I <sup>1</sup>	4
<b>Hours</b>		<b>14</b>

### Spring Semester

ECE 109	Introduction to Computer Systems <sup>2</sup>	3
MA 241	Calculus II <sup>1</sup>	4
PY 205 & PY 206	Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory <sup>1</sup>	4
Select one of the following Economics courses:		3
ARE 201	Introduction to Agricultural & Resource Economics	
ARE 201A	Introduction to Agricultural & Resource Economics	
EC 201	Principles of Microeconomics	
EC 205	Fundamentals of Economics	
<b>Hours</b>		<b>14</b>

### Second Year

#### Fall Semester

ECE 200	Introduction to Signals, Circuits and Systems <sup>2</sup>	4
ECE 209	Computer Systems Programming <sup>2</sup>	3
MA 242	Calculus III	4
PY 208 & PY 209	Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory	4
<b>Hours</b>		<b>15</b>

#### Spring Semester

COM 110	Public Speaking	3
ECE 211	Electric Circuits <sup>2</sup>	4
ECE 212	Fundamentals of Logic Design <sup>2</sup>	3
ECE 220	Analytical Foundations of Electrical and Computer Engineering <sup>2</sup>	3
<b>Hours</b>		<b>13</b>

### Third Year

#### Fall Semester

ECE 301	Linear Systems	3
ECE 302	Microelectronics	4
ST 371	Introduction to Probability and Distribution Theory	3
<b>Hours</b>		<b>10</b>

#### Spring Semester

ECE 303	Electromagnetic Fields	3
ECE 380	Engineering Profession for Electrical Engineers	1
ECE 305	Principles of Electromechanical Energy Conversion	3
Select one of the following ECE 3** Foundation courses:		3
E 304	Introduction to Nano Science and Technology	
ECE 306	Introduction to Embedded Systems	
ECE 308	Elements of Control Systems	
ECE 310	Design of Complex Digital Systems	
ENG 331	Communication for Engineering and Technology	3
<b>Hours</b>		<b>13</b>

**Fourth Year****Fall Semester**

Select one of the following Senior Design Project I courses: 3

ECE 482	Engineering Entrepreneurship and New Product Development I	
ECE 484	Electrical and Computer Engineering Senior Design I	
ECE 452	Renewable Electric Energy Systems	3
REES Electives (p. 2)		6
<b>Hours</b>		<b>12</b>

**Spring Semester**

Select one of the following Senior Design Project II courses: 3

ECE 483	Engineering Entrepreneurship and New Product Development II	
ECE 485	Electrical and Computer Engineering Senior Design II	
ECE Elective (p. 2)		3
Open/Technical Electives (p. 4)		6
<b>Hours</b>		<b>12</b>
<b>Total Hours</b>		<b>103</b>

<sup>1</sup> A grade of C or higher is required.<sup>2</sup> A grade of C- or higher is required.

Code	Title	Hours	Counts towards
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**GEP Courses**

GEP Humanities ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/</a> )		6	
GEP Social Sciences ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/</a> )		3	
GEP Health and Exercise Studies ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/</a> )		2	
GEP US Diversity, Equity, and Inclusion ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-usdei/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-usdei/</a> )		3	
GEP Interdisciplinary Perspectives ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/</a> )		5	
GEP Global Knowledge ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/</a> ) (verify requirement)			

Foreign Language Proficiency (<http://catalog.ncsu.edu/undergraduate/gep-category-requirements/foreign-language-proficiency/>) (verify requirement)

<b>Total Hours</b>	<b>19</b>
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**REES Electives**

Code	Title	Hours	Counts towards
ECE 434	Fundamentals of Power Electronics	3	
ECE 451	Power System Analysis	3	
ECE 453	Electric Motor Drives	3	
ECE 533	Power Electronics Design & Packaging	3	
ECE 534	Power Electronics	3	
ECE 535	Design of Electromechanical Systems	3	
ECE 550	Power System Operation and Control	3	
ECE 551	Smart Electric Power Distribution Systems	3	
ECE 553	Semiconductor Power Devices	3	
ECE 581	Electric Power System Protection	3	
ECE 583	Electric Power Engineering Practicum I	3	
ECE 585	The Business of the Electric Utility Industry	3	
ECE 586	Communication and SCADA Systems for Smart Grid	3	
MAE 535	Design of Electromechanical Systems	3	

**ECE Electives****ECE Elective**

Code	Title	Hours	Counts towards
ECE 402	Communications Engineering	3	

ECE 403	Electronics Engineering	3	ECE 463/563	Microprocessor Architecture	3
ECE 404	Introduction to Solid-State Devices	3	ECE 464/564	ASIC and FPGA Design with Verilog	3
ECE 406/506	Architecture Of Parallel Computers	3	ECE 466	Compiler Optimization and Scheduling	3
ECE 407	Introduction to Computer Networking	3	ECE 470	Internetworking	3
ECE 418/518	Wearable Biosensors and Microsystems	3	ECE 489/589	Solid State Solar and Thermal Energy Harvesting	3
ECE 420	Wireless Communication Systems	3	ECE 492	Special Topics in Electrical and Computer Engineering	1-4
ECE 421	Introduction to Signal Processing	3	ECE 505	Neural Interface Engineering	3
ECE 422	Transmission Lines and Antennas for Wireless	3	ECE 511	Analog Electronics	3
ECE 423	Introduction to Photonics and Optical Communications	3	ECE 513	Digital Signal Processing	3
ECE 424/524	Radio System Design	3	ECE 514	Random Processes	3
ECE 426	Analog Electronics Laboratory	3	ECE 515	Digital Communications	3
ECE 434	Fundamentals of Power Electronics	3	ECE 516	System Control Engineering	3
ECE 436	Digital Control Systems	3	ECE 517	Object-Oriented Design and Development	3
ECE 442	Introduction to Integrated Circuit Technology and Fabrication	3	ECE 522	Medical Instrumentation	3
ECE 451	Power System Analysis	3	ECE 523	Photonics and Optical Communications	3
ECE 452/552	Renewable Electric Energy Systems	3	ECE 530	Physical Electronics	3
ECE 453	Electric Motor Drives	3	ECE 531	Principles Of Transistor Devices	3
ECE 455	Industrial Robot Systems	3	ECE 532	Principles Of Microwave Circuits	3
ECE 456/556	Mechatronics	3	ECE 533	Power Electronics Design & Packaging	3
ECE 460/560	Embedded System Architectures	3	ECE 534	Power Electronics	3
ECE 461/561	Embedded System Analysis and Optimization	3	ECE 535	Design of Electromechanical Systems	3
			ECE 540	Electromagnetic Fields	3
			ECE 542	Neural Networks	3

ECE 544	Design Of Electronic Packaging and Interconnects	3
ECE 546	VLSI Systems Design	3
ECE 549	RF Design for Wireless	3
ECE 550	Power System Operation and Control	3
ECE 551	Smart Electric Power Distribution Systems	3
ECE 553	Semiconductor Power Devices	3
ECE 555	Autonomous Robot Systems	3
ECE 557	Principles Of MOS Transistors	3
ECE 558	Digital Imaging Systems	3
ECE 568	Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems	3
ECE 570	Computer Networks	3
ECE 573	Internet Protocols	3
ECE 574	Computer and Network Security	3
ECE 575	Introduction to Wireless Networking	3
ECE 577	Switched Network Management	3
ECE 581	Electric Power System Protection	3
ECE 582	Wireless Communication Systems	3
ECE 583	Electric Power Engineering Practicum I	3
ECE 585	The Business of the Electric Utility Industry	3
ECE 586	Communication and SCADA Systems for Smart Grid	3

ECE 592	Special Topics In Electrical Engineering	1-6
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## Open/Technical Elective

### Open Electives

Choose from the ECE Elective List or the other Open Electives listed below

#### ECE Elective

Code	Title	Hours	Counts towards
ECE 402	Communications Engineering	3	
ECE 403	Electronics Engineering	3	
ECE 404	Introduction to Solid-State Devices	3	
ECE 406/506	Architecture Of Parallel Computers	3	
ECE 407	Introduction to Computer Networking	3	
ECE 418/518	Wearable Biosensors and Microsystems	3	
ECE 420	Wireless Communication Systems	3	
ECE 421	Introduction to Signal Processing	3	
ECE 422	Transmission Lines and Antennas for Wireless	3	
ECE 423	Introduction to Photonics and Optical Communications	3	
ECE 424/524	Radio System Design	3	
ECE 426	Analog Electronics Laboratory	3	
ECE 434	Fundamentals of Power Electronics	3	
ECE 436	Digital Control Systems	3	
ECE 442	Introduction to Integrated Circuit Technology and Fabrication	3	
ECE 451	Power System Analysis	3	

ECE 452/552	Renewable Electric Energy Systems	3	ECE 532	Principles Of Microwave Circuits	3
ECE 453	Electric Motor Drives	3	ECE 533	Power Electronics Design & Packaging	3
ECE 455	Industrial Robot Systems	3	ECE 534	Power Electronics	3
ECE 456/556	Mechatronics	3	ECE 535	Design of Electromechanical Systems	3
ECE 460/560	Embedded System Architectures	3	ECE 540	Electromagnetic Fields	3
ECE 461/561	Embedded System Analysis and Optimization	3	ECE 542	Neural Networks	3
ECE 463/563	Microprocessor Architecture	3	ECE 544	Design Of Electronic Packaging and Interconnects	3
ECE 464/564	ASIC and FPGA Design with Verilog	3	ECE 546	VLSI Systems Design	3
ECE 466	Compiler Optimization and Scheduling	3	ECE 549	RF Design for Wireless	3
ECE 470	Internetworking	3	ECE 550	Power System Operation and Control	3
ECE 489/589	Solid State Solar and Thermal Energy Harvesting	3	ECE 551	Smart Electric Power Distribution Systems	3
ECE 492	Special Topics in Electrical and Computer Engineering	1-4	ECE 553	Semiconductor Power Devices	3
ECE 505	Neural Interface Engineering	3	ECE 555	Autonomous Robot Systems	3
ECE 511	Analog Electronics	3	ECE 557	Principles Of MOS Transistors	3
ECE 513	Digital Signal Processing	3	ECE 558	Digital Imaging Systems	3
ECE 514	Random Processes	3	ECE 568	Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems	3
ECE 515	Digital Communications	3	ECE 570	Computer Networks	3
ECE 516	System Control Engineering	3	ECE 573	Internet Protocols	3
ECE 517	Object-Oriented Design and Development	3	ECE 574	Computer and Network Security	3
ECE 522	Medical Instrumentation	3	ECE 575	Introduction to Wireless Networking	3
ECE 523	Photonics and Optical Communications	3	ECE 577	Switched Network Management	3
ECE 530	Physical Electronics	3			
ECE 531	Principles Of Transistor Devices	3			

ECE 581	Electric Power System Protection	3	
ECE 582	Wireless Communication Systems	3	
ECE 583	Electric Power Engineering Practicum I	3	
ECE 585	The Business of the Electric Utility Industry	3	
ECE 586	Communication and SCADA Systems for Smart Grid	3	
ECE 592	Special Topics In Electrical Engineering	1-6	
<b>Code</b>	<b>Title</b>	<b>Hours</b>	<b>Counts towards</b>
E 304	Introduction to Nano Science and Technology	3	
ECE 305	Principles of Electromechanical Energy Conversion	3	
ECE 306	Introduction to Embedded Systems	3	
ECE 308	Elements of Control Systems	3	
ECE 309	Data Structures and Object-Oriented Programming for Electrical and Computer Engineers	3	
ECE 310	Design of Complex Digital Systems	3	
CE 214	Engineering Mechanics-Statics	3	
or MAE 206	Engineering Statics		
MSE 200	Mechanical Properties of Structural Materials	3	
or MSE 201	Structure and Properties of Engineering Materials		
ISE 311	Engineering Economic Analysis	3	
MAE 208	Engineering Dynamics	3	

MAE 201	Engineering Thermodynamics I	3
MAE 302/ BME 525	Engineering Thermodynamics II	3

## Semester Sequence

This is a sample.

### First Year

Fall Semester		Hours
CH 101	Chemistry - A Molecular Science <sup>1</sup>	3
CH 102	General Chemistry Laboratory <sup>1</sup>	1
E 101	Introduction to Engineering & Problem Solving <sup>2</sup>	1
E 115	Introduction to Computing Environments	1
ENG 101	Academic Writing and Research	4
MA 141	Calculus I <sup>1</sup>	4
GEP Requirement ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )		3
<b>Hours</b>		<b>17</b>

### Spring Semester

ECE 109	Introduction to Computer Systems <sup>2</sup>	3
MA 241	Calculus II <sup>1</sup>	4
PY 205	Physics for Engineers and Scientists I <sup>1</sup>	3
PY 206	Physics for Engineers and Scientists I Laboratory	1
GEP Health and Exercise Studies ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/</a> )		1
EC 205	Fundamentals of Economics	3
<b>Hours</b>		<b>15</b>

### Second Year

#### Fall Semester

ECE 200	Introduction to Signals, Circuits and Systems <sup>2</sup>	4
ECE 209	Computer Systems Programming <sup>2</sup>	3
MA 242	Calculus III	4
PY 208	Physics for Engineers and Scientists II	3
<b>Hours</b>		<b>14</b>

#### Spring Semester

COM 110	Public Speaking	3
ECE 211	Electric Circuits <sup>2</sup>	4
ECE 212	Fundamentals of Logic Design <sup>2</sup>	3
ECE 220	Analytical Foundations of Electrical and Computer Engineering <sup>2</sup>	3
GEP Requirement ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )		3
<b>Hours</b>		<b>16</b>

### Third Year

#### Fall Semester

ECE 301	Linear Systems	3
ECE 302	Microelectronics	4

ST 371	Introduction to Probability and Distribution Theory	3
ECE 305	Principles of Electromechanical Energy Conversion	3
GEP Health and Exercise Studies ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/</a> )		1
<b>Hours</b>		<b>14</b>
<b>Spring Semester</b>		
ECE 303	Electromagnetic Fields	3
ECE 380	Engineering Profession for Electrical Engineers <sup>3</sup>	1
REES Elective (p. 2) <sup>4</sup>		3
Select one of the following Foundation Electives:		3
E 304	Introduction to Nano Science and Technology	
ECE 306	Introduction to Embedded Systems	
ECE 308	Elements of Control Systems	
ECE 310	Design of Complex Digital Systems	
ENG 331	Communication for Engineering and Technology	3
GEP Requirement ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )		3
<b>Hours</b>		<b>16</b>
<b>Fourth Year</b>		
<b>Fall Semester</b>		
ECE 484	Electrical and Computer Engineering Senior Design I <sup>3</sup>	3
REES Electives (p. 2) <sup>4</sup>		3
ECE 452	Renewable Electric Energy Systems	3
Open/Technical Elective (p. 4)		3
GEP Requirement ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )		3
<b>Hours</b>		<b>15</b>
<b>Spring Semester</b>		
ECE 485	Electrical and Computer Engineering Senior Design II <sup>4</sup>	3
ECE Elective (p. 2) <sup>5</sup>		3
GEP Requirement ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )		3
Open/Technical Electives (p. 4)		3
GEP Requirement ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )		2-3
<b>Hours</b>		<b>14-15</b>
<b>Total Hours</b>		<b>121-122</b>

<sup>1</sup> A grade of C or higher is required.

<sup>2</sup> A grade of C- or higher is required.

<sup>3</sup> Students in the entrepreneurs program should take ECE 383/ECE 482/ECE 483, instead of ECE 380/ECE 484/ECE 485.

<sup>4</sup> Major GPAs greater than 3.5 are required to take 5xx courses.

<sup>5</sup> Students with major GPAs greater than 3.5 can take 5xx courses