Computer Engineering (BS): Embedded Systems Concentration

The CPE core courses provide a foundation for all CPE students in electric circuits, digital logic, computer systems, programming, signals, linear systems, embedded systems, discrete math, data structures, teaming and communication, and the social and ethical dimensions of the practice of electrical and computer engineering.

Students will select a concentration for their CPE degree. CPE offers a robust set of concentrations to guide students in their studies. All concentrations within CPE share the core courses required by the major. Concentrations are offered in the following areas: Artificial Intelligence and Machine Learning, Computer Architecture and Emerging Systems, Computer Systems Software, Embedded Systems, Networking Hardware, and Networking Software.

Each CPE concentration contains 22 hours of work. Students will take 12 hours from a prescribed list of courses that provide the necessary depth and background to pursue a career in the area. An additional 10 hours from a broader list of “open” electives are also required as part of the concentration, and these are meant to reinforce and add breadth to that area. There are many connections between areas and too many to explicitly list, and therefore, the open category gives students the freedom to choose courses that either broaden or deepen their expertise as they determine appropriate in consultation with their advisor. Furthermore, the open elective list intentionally allows students to take courses outside of ECE, such as other engineering, math, or science courses.

In their final year, all Computer Engineering majors participate in a two-semester senior design course sequence. Students work in teams to solve an engineering problem identified by faculty or industrial sponsors. Over the course of two semesters, students gain experience designing, documenting, and communicating about their project to various audiences.

This curriculum leads to a Bachelor of Science in Computer Engineering and is nationally accredited by ABET, http://www.abet.org.

Plan Requirements

Code	Title	Hours
Major Field of Study Requirements		
Math		
MA 141	Calculus I [1,2]	4
MA 241	Calculus II [1,2]	4
MA 242	Calculus III	4
ST 371	Introduction to Probability and Distribution Theory	3
Science		
CH 101 & CH 102	Chemistry - A Molecular Science and General Chemistry Laboratory [1,2]	4
PY 205	Physics for Engineers and Scientists I [1,2]	4
PY 208	Physics for Engineers and Scientists II	4
Computer Engineering Core Courses		
ECE 109	Introduction to Computer Systems [3]	3
ECE 200	Introduction to Signals, Circuits and Systems [3]	4
ECE 209	Computer Systems Programming [3]	3
ECE 211	Electric Circuits [3]	4
ECE 212	Fundamentals of Logic Design [3]	3
ECE 220	Analytical Foundations of Electrical and Computer Engineering [3]	3
CSC 226	Discrete Mathematics [3]	3
ECE 301	Linear Systems	3
ECE 306	Introduction to Embedded Systems	3
ECE 309	Data Structures and Object-Oriented Programming for Electrical and Computer Engineers	3
ECE 381	Engineering Profession for Computer Engineers	1
or ECE 380	Engineering Profession for Electrical Engineers	
or ECE 383	Introduction to Entrepreneurship and New Product Development	
ECE 484	Electrical and Computer Engineering Senior Design I	3
or ECE 482	Engineering Entrepreneurship Senior Design I	
ECE 485	Electrical and Computer Engineering Senior Design II	3
or ECE 483	Engineering Entrepreneurship Senior Design II	
Embedded Systems Concentration		
ECE 310	Design of Complex Digital Systems	3
ECE 460 or ECE 560	[4]	3
Embedded Systems Electives (p. 2)		6
Open Electives (p.) [5]		10
Other Major Requirements		
COM 110	Public Speaking	3
ENG 331	Communication for Engineering and Technology	3
College Requirements		
E 101	Introduction to Engineering & Problem Solving [3]	1
E 102	Engineering in the 21st Century [3]	2
E 115	Introduction to Computing Environments [3]	1
EC 205	Fundamentals of Economics	3
or EC 201	Principles of Microeconomics	
or ARE 201	Introduction to Agricultural & Resource Economics	
or ARE 201A	Introduction to Agricultural & Resource Economics	
Total Hours		**101**

Code	Title	Hours
GEP Courses		
ENG 101	Academic Writing and Research [3]	4
GEP Humanities (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)		6
GEP Social Sciences (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)		3
GEP Health and Exercise Studies (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		2
GEP Interdisciplinary Perspectives (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/)		3

GEP Elective (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/)	3
GEP Global Knowledge (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/) (verify requirement)	
GEP Foundations of American Democracy (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-fad/) (verify requirement)	
World Language Proficiency (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/world-language-proficiency/) (verify requirement)	
Total Hours	**21**

Embedded Systems Electives

Code	Title	Hours
ECE 384	Practical Engineering Prototyping	3
ECE 406	Architecture Of Parallel Computers [4]	3
or ECE 506	Architecture Of Parallel Computers	
ECE 461	Embedded System Analysis and Optimization	3
or ECE 561	Embedded System Analysis and Optimization	
ECE 463	Microprocessor Architecture [4]	3
or ECE 563	Microprocessor Architecture	
ECE 464	ASIC and FPGA Design with Verilog [4]	3
or ECE 564	ASIC and FPGA Design with Verilog	
ECE 465	Operating Systems Design [4]	3
or ECE 565	Operating Systems Design	
ECE 466	Compiler Optimization and Scheduling [4]	3
or ECE 566	Compiler Optimization and Scheduling	

Open Electives

Open Electives

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

ECE Elective

Code	Title	Hours
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 410/510	Introduction to Signal Processing	3
ECE 411	Introduction to Machine Learning	3
ECE 418/518	Wearable Biosensors and Microsystems	3
ECE 420	Wireless Communication Systems	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 425	Neural Networks and Deep Learning	3
ECE 426	Analog Electronics Hands-on Design	3
ECE 434	Fundamentals of Power Electronics	3
ECE 436	Digital Control Systems	3
ECE 441	Robot Motion Planning	3
ECE 442	Introduction to Integrated Circuit Technology and Fabrication	3
ECE 448/548	Python in ECE	3
ECE 451	Power System Analysis	3
ECE 452/552	Renewable Electric Energy Systems	3
ECE 453	Electric Motor Drives	3
ECE 455/555	Industrial Robotic Systems	3
ECE 460/560		3
ECE 461/561	Embedded System Analysis and Optimization	3
ECE 463/563	Microprocessor Architecture	3
ECE 464/564	ASIC and FPGA Design with Verilog	3
ECE 465/565	Operating Systems Design	3
ECE 466/566	Compiler Optimization and Scheduling	3
ECE 468/568	Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems	3
ECE 469	Quantum Programming	3
ECE 470	Internetworking	3
ECE 488/588	Systems Biology Modeling of Plant Regulation	3
ECE 489/589	Solid State Solar and Thermal Energy Harvesting	3
ECE 492	Special Topics in Electrical and Computer Engineering	1-4
ECE 502	Wide Bandgap Semiconductor Devices and Applications	3
ECE 505	Neural Interface Engineering	3
ECE 511	Analog Electronics	3
ECE 512	Data Science from a Signal Processing Perspective	3
ECE 514	Random Processes	3
ECE 515	Digital Communications	3
ECE 516	System Control Engineering	3
ECE 517	Object-Oriented Design and Development	3
ECE 522	Medical Instrumentation	3
ECE 523	Photonics and Optical Communications	3
ECE 525	Neural Networks and Deep Learning	3
ECE 530	Physics of Semiconductors	3
ECE 533	Power Electronics Design & Packaging	3
ECE 534	Power Electronics	3
ECE 535	Design of Electromechanical Systems	3
ECE 536	Digital Control System Projects	3
ECE 538	Integrated Circuits Technology and Fabrication	3
ECE 540	Electromagnetic Fields	3
ECE 541	Antennas and Arrays	3
ECE 544	Design Of Electronic Packaging and Interconnects	3
ECE 545	Cryptographic Engineering and Hardware Security	3
ECE 546	VLSI Systems Design	3
ECE 547	Cloud Computing Technology	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 554	Electric Motor Drives	3
ECE 555	Autonomous Robot Systems	3

ECE 557	Principles Of MOS Transistors	3
ECE 558	Digital Imaging Systems	3
ECE 569	Quantum Computing	3
ECE 570	Computer Networks	3
ECE 571	Internet of Things: Architectures, Applications, and Implementation	3
ECE 572	Optimizations and Algorithms	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 578	LTE and 5G Communications	3
ECE 579	Introduction to Computer Performance Modeling	3
ECE 581	Electric Power System Protection	3
ECE 583	Electric Power Engineering Practicum I	3
ECE 584	Electric Power Engineering Practicum II	3
ECE 585	The Business of the Electric Utility Industry	3
ECE 586	Communication and SCADA Systems for Smart Grid	3
ECE 587	Power System Transients Analysis	3
ECE 591	Special Topics In Electrical Engineering	1-6
ECE 592	Special Topics In Electrical Engineering	1-6

Code	Title	Hours
ECE 302	Microelectronics	4
ECE 303	Electromagnetic Fields	3
ECE 304	Fundamentals of Semiconductor Devices	3
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
ECE 366	Design and Analysis of Algorithms	3
ECE 384	Practical Engineering Prototyping	3
CE 214 or MAE 206	Engineering Mechanics-Statics Engineering Statics	3
MSE 200 or MSE 201	Mechanical Properties of Structural Materials Structure and Properties of Engineering Materials	3
ISE 311	Engineering Economic Analysis	3
MAE 208	Engineering Dynamics	3
MAE 201	Thermal-Fluid Sciences	3
MAE 302/ BME 525	Engineering Thermodynamics II	3
DSA 200 or higher level courses, up to 3 credit hours		3
College of Science courses 400-level or higher with permission of advisor		
College of Engineering Courses 400-level or higher with permission of advisor		

1 Course required for Change of Degree Audit (CODA).
2 A grade of C or higher is required.
3 A grade of C- or higher is required.
4 Minimum 3.5 GPA required to enroll in graduate classes.
5 Suggested open electives, depending on interests of the student, include power systems (ECE 305, ECE 434, ECE 452, ECE 453), communications and signal processing (ECE 402, 410/510, 411, 420, 425, 512), networking (ECE 407, 470), biomedical instrumentation (ECE 418), hardware design (ECE 464/564, ECE 463/563) and systems software (ECE 465/565, ECE 466/566).

First Year

Fall Semester		**Hours**
CH 101	Chemistry - A Molecular Science [1,2]	3
CH 102	General Chemistry Laboratory [1,2]	1
E 101	Introduction to Engineering & Problem Solving [3]	1
E 115	Introduction to Computing Environments [3]	1
ENG 101	Academic Writing and Research [3]	4
MA 141	Calculus I [1,2]	4
GEP Health and Exercise Studies (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
	Hours	**15**
Spring Semester		
ECE 109	Introduction to Computer Systems [3]	3
MA 241	Calculus II [1,2]	4
PY 205	Physics for Engineers and Scientists I [1,2]	4
E 102	Engineering in the 21st Century [3]	2
EC 205 or EC 201 or ARE 201 or ARE 201A	Fundamentals of Economics or Principles of Microeconomics or Introduction to Agricultural & Resource Economics or Introduction to Agricultural & Resource Economics	3
	Hours	**16**

Second Year

Fall Semester		
ECE 200	Introduction to Signals, Circuits and Systems [3]	4
ECE 209	Computer Systems Programming [3]	3
MA 242	Calculus III	4
PY 208	Physics for Engineers and Scientists II [1]	4
	Hours	**15**
Spring Semester		
COM 110	Public Speaking	3
CSC 226	Discrete Mathematics [3]	3
ECE 211	Electric Circuits [3]	4
ECE 212	Fundamentals of Logic Design [3]	3
ECE 220	Analytical Foundations of Electrical and Computer Engineering [3]	3
	Hours	**16**

Third Year

Fall Semester		
ECE 301	Linear Systems	3
ECE 306	Introduction to Embedded Systems	3

ECE 309	Data Structures and Object-Oriented Programming for Electrical and Computer Engineers	3
ST 371	Introduction to Probability and Distribution Theory	3
GEP Requirement (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
	Hours	**15**
Spring Semester		
ECE 310	Design of Complex Digital Systems	3
Select one of the following:		1
ECE 381	Engineering Profession for Computer Engineers	
ECE 380	Engineering Profession for Electrical Engineers	
ECE 383	Introduction to Entrepreneurship and New Product Development	
Open Electives (p. 2) [5]		7
ENG 331	Communication for Engineering and Technology	3
GEP Health and Exercise Studies (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
	Hours	**15**
Fourth Year		
Fall Semester		
ECE 484	Electrical and Computer Engineering Senior Design I	3
ECE 460 or ECE 560 [4]	or	3
Embedded Systems Elective (p. 2)		3
GEP Requirement (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
GEP Requirement (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
	Hours	**15**
Spring Semester		
ECE 485	Electrical and Computer Engineering Senior Design II	3
Embedded Systems Elective (p. 2)		3
Open Electives (p.) [5]		3
GEP Requirement (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
GEP Requirement (https://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
	Hours	**15**
	Total Hours	**122**

1. Course required for Change of Degree Audit (CODA).
2. A grade of C or higher is required.
3. A grade of C- or higher is required.
4. A minimum GPA of 3.5 is required to enroll in graduate-level courses.
5. Suggested open electives, depending on interests of the student, include power systems (ECE 305, ECE 434, ECE 452, ECE 453), communications and signal processing (ECE 402, 410/510, 411, 420, 425, 512), networking (ECE 407, 470), biomedical instrumentation (ECE 418), hardware design (ECE 464/564, ECE 463/563) and systems software (ECE 465/565, ECE 466/566).

A computer engineering degree unlocks a vast array of exciting career opportunities at the forefront of technology. Graduates can delve into roles such as hardware engineers—designing and optimizing the next generation of computing devices—or software engineers who crafting innovative applications and systems that drive technological progress. You have career opportunities in fields like cybersecurity or you can delve into artificial intelligence and machine learning, developing algorithms that power intelligent systems.

Additionally, opportunities abound in areas such as embedded systems, where engineers create the brains behind smart devices, and in networking, where they build the backbone of our connected world. Moreover, with the rapid expansion of fields like the Internet of Things, augmented reality, and quantum computing, the possibilities for computer engineering professionals are continually expanding, offering avenues for creative problem-solving and impactful innovation across industries.

Whether in established tech giants like Apple, Samsung, or Analog Devices, cutting-edge startups, research institutions, or entrepreneurial ventures, computer engineering graduates are poised to shape the future of technology and drive meaningful change in society.

You can see some currently-hiring positions in ePack (https://my.ece.ncsu.edu/careers/jobs/) for examples of career paths.

Career Titles

- Architectural Drafters
- Automotive Engineering Technicians
- Computer and Information Scientists
- Computer and Information Systems Managers
- Computer Hardware Engineers
- Computer Network Architects
- Computer Programmer
- Computer Systems Analyst
- Computer Systems Engineer
- Database Administrator
- Database Architects
- Electrical and Electronic Engineering Technologists and Technicians
- Engineering Professor
- Information Security Analysts
- Sales Representative (Computers)
- Software Developers - Applications
- Telecommunications Engineering Specialists

Learn More About Careers

NCcareers.org (https://nccareers.org/)
Explore North Carolina's central online resource for students, parents, educators, job seekers and career counselors looking for high quality job and career information.

Occupational Outlook Handbook (https://www.bls.gov/ooh/)
Browse the Occupational Outlook Handbook published by the Bureau of Labor Statistics to view state and area employment and wage statistics. You can also identify and compare similar occupations based on your interests.

Career One Stop Videos (https://www.careeronestop.org/)
View videos that provide career details and information on wages, employment trends, skills needed, and more for any occupation. Sponsored by the U.S. Department of Labor.

Focus 2 Career Assessment (https://careers.dasa.ncsu.edu/explore-careers/career-assessments/) (NC State student email address required)
This career, major and education planning system is available to current NC State students to learn about how your values, interests, competencies, and personality fit into the NC State majors and your future career. An NC State email address is required to create an account. Make an appointment with your career counselor (https://careers.dasa.ncsu.edu/about/hours-appointments/) to discuss the results.

Focus 2 Apply Assessment (https://www.focus2career.com/Portal/Register.cfm?SID=1929) (Available to prospective students)
A career assessment tool designed to support prospective students in exploring and choosing the right major and career path based on your unique personality, interests, skills and values. Get started with Focus 2 Apply and see how it can guide your journey at NC State.

Institute of Electrical and Electronics Engineers (http://www.ieee.org/)
National Association of Professional Engineers (https://www.nspe.org/)