

MAJOR IN COMPUTER ENGINEERING, VLSI AND INTEGRATED CIRCUITS CONCENTRATION

Very large-scale integration, or VLSI, is the process used to design and create computer chips that enable everything from smart watches to virtual reality applications. This concentration offers students a foundation in computer engineering with specialized training in the VLSI and microelectronics disciplines. VLSI focuses on developing advanced electronic circuits and systems to compute massive amounts of data and turn it into meaningful information. For example, when sensors on self-driving cars collect data to assess the vehicle's surroundings, such as lane markings, pedestrians, and road signs, VLSI provides the "smarts" to turn that sensing data into actionable insights to control the car. Coursework in this concentration focuses on applications of key computer engineering principles in the areas of digital systems,

computer-aided design, integrated circuits, embedded systems and microelectronics, computer networks, and more. These courses will enable and encourage students to design, analyze, optimize, and implement components, circuits, and systems that are essential in our daily lives.

Requirements Effective Fall 2022

In order to maintain professional standards required of practicing engineers, the Department of Electrical and Computer Engineering requires a cumulative grade point average of at least 2.000 in Electrical Engineering courses as a graduation requirement. It is the responsibility of any student who fails to maintain a 2.000 average to work with their advisor to correct grade point deficiencies. ECE courses required for the major at the 100, 200, and 300 level must be passed with a minimum grade of C (2.000); grades below a C will require the student to retake the course. ECE courses designated as an elective are exempt from the C or higher minimum grade requirement.

Freshman

		AUCC	Credits
CO 150	College Composition (GT-CO2)	1A	3
CS 163 or 164	CS1—No Prior Programming Experience CS1—Computational Thinking with Java		4
CS 165	CS2—Data Structures		4
ECE 102	Digital Circuit Logic		4
ECE 251	Introduction to Microcontrollers and IoT		4
MATH 160	Calculus for Physical Scientists I (GT-MA1)	1B	4
MATH 161	Calculus for Physical Scientists II (GT-MA1)	1B	4
Diversity, Equity, and Inclusion (http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#diversity-equity-inclusion)			3
Career Development Seminar ¹			
Total Credits			30

Sophomore

CS 220	Discrete Structures and their Applications		4
ECE 103	DC Circuit Analysis		3
ECE 202	Circuit Theory Applications		4
ECE 232	Introduction to Project Practices		1
ECE 303/STAT 303	Introduction to Communications Principles		3
MATH 261	Calculus for Physical Scientists III		4
MATH 340	Intro to Ordinary Differential Equations		4
PH 141	Physics for Scientists and Engineers I (GT-SC1)	3A	5
PH 142	Physics for Scientists and Engineers II (GT-SC1)	3A	5
Career Development Seminar ¹			
Total Credits			33

Junior

CS 253	Software Development with C++		4
ECE 311	Linear System Analysis I		3
ECE 331	Electronics Principles I		4
ECE 332	Electronics Principles II		4

ECE 450	Digital System Design Laboratory		1
ECE 451	Digital System Design		3
ECE 452	Computer Organization and Architecture		3
ECON 202	Principles of Microeconomics (GT-SS1)	3C	3
Select a minimum of three credits from the following:			3
DSCI 369	Linear Algebra for Data Science		
MATH 369	Linear Algebra I		
Select one course from the following:			3
CO 301B	Writing in the Disciplines: Sciences (GT-CO3)	2	
JTC 300	Strategic Writing and Communication (GT-CO3)	2	
Career Development Seminar ¹			

Total Credits **31**

Senior

ECE 340	Electromagnetics for Computer Engineering		3
ECE 401	Senior Design Project I	4A,4B	3
ECE 402	Senior Design Project II	4C	3
ECE 456	Computer Networks		4
Select a minimum of three credits from the following:			3
CS 356	Systems Security		
ECE 528/CS 528	Embedded Systems and Machine Learning		
Computer Engineering Electives and Technical Electives			7
Arts and Humanities (http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities)			3B
Historical Perspectives (http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#historical-perspectives)			3D
Career Development Seminar ¹			

Total Credits **32**

Program Total Credits: **126**

Computer Engineering Electives 0-3 credits

Code	Title	Credits
ECE 101	Foundations in ECE	1
ECE 312	Linear System Analysis II	3
ECE 395A	Independent Study ²	1-3
ECE 395B	Independent Study: Open Option Project ²	1
ECE 395C	Independent Study : Vertically Integrated Project ²	1

Technical Electives 2-7 credits

Code	Title	Credits
CS 356	Systems Security ³	3
ECE 4XX	Any ECE course at the 400-level	3-4
Select any course from the following: ²		1-3
ECE 495A	Independent Study	
ECE 495B	Independent Study: Open Option Project	
ECE 495C	Independent Study: Vertically Integrated Projects	
ECE 520	Optimization Methods-Control & Communication	3

ECE 528/CS 528 ₃	Embedded Systems and Machine Learning	4
ECE 534	Analog Integrated Circuit Design	3
ECE 535	Analog Integrated Circuit Laboratory	1
ECE 536	RF Integrated Circuit Design	3
ECE 538	Design/Analysis of Analog Digital Interface	4
ECE 541	Applied Electromagnetics	3
ECE 544	Silicon Photonics for Computing Systems	3
ECE 545	FPGA Signal Processing/Software-Defined Radio	3
ECE 554	Computer Architecture	3
ECE 558	Manycore System Design Using Machine Learning	3
ECE 561/CS 561	Hardware/Software Design of Embedded Systems	4
ECE 571	VLSI System Design	3
ECE 575	Experiments in VLSI System Design I	1
MATH 450	Introduction to Numerical Analysis I	3
MATH 451	Introduction to Numerical Analysis II	3
STAT 421	Introduction to Stochastic Processes	3

¹ Students are required to complete three Career Development Seminars: 1) Resume Writing; 2) Behavior Based Interviewing; and 3) Using

LinkedIn™. Completion of the required workshops may be spread over the student's four-year program.

² A total 6 credits of Independent Study may apply toward total degree requirements. This includes credit awarded for ECE 395A, ECE 395B, ECE 395C and ECE 495A, ECE 495B, ECE 495C combined.

³ Course may count as a Technical Elective ONLY when not taken as part of the major requirements. The course cannot count as credit toward both major and technical elective requirements.

Major Completion Map

Distinctive Requirements for Degree Program:

TO PREPARE FOR FIRST SEMESTER: The curriculum for this major assumes students enter college prepared to take calculus.

The ECE curriculum has been modified as part of the Revolutionizing Engineering Departments initiative (RED). Three threads run through the new curriculum: Foundations, Creativity and Professional Formation

Freshman

Semester 1		Critical	Recommended	AUCC	Credits
CO 150	College Composition (GT-CO2)		X	1A	3
CS 163 or 164	CS1--No Prior Programming Experience CS1--Computational Thinking with Java	X			4
ECE 102	Digital Circuit Logic	X			4
MATH 160	Calculus for Physical Scientists I (GT-MA1)	X		1B	4
Career Development Seminar(s)			X		
Total Credits					15
Semester 2		Critical	Recommended	AUCC	Credits
CS 165	CS2--Data Structures	X			4
ECE 251	Introduction to Microcontrollers and IoT	X			4
MATH 161	Calculus for Physical Scientists II (GT-MA1)	X		1B	4
Diversity, Equity, and Inclusion (http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#diversity-equity-inclusion)		X		1C	3
Career Development Seminar(s)			X		
Total Credits					15

Sophomore

Semester 3		Critical	Recommended	AUCC	Credits
CS 220	Discrete Structures and their Applications	X			4
ECE 103	DC Circuit Analysis	X			3
MATH 261	Calculus for Physical Scientists III	X			4
PH 141	Physics for Scientists and Engineers I (GT-SC1)	X		3A	5
Career Development Seminar(s)			X		
Total Credits					16
Semester 4		Critical	Recommended	AUCC	Credits
ECE 202	Circuit Theory Applications	X			4
ECE 232	Introduction to Project Practices	X			1
ECE 303/ STAT 303	Introduction to Communications Principles	X			3
MATH 340	Intro to Ordinary Differential Equations	X			4
PH 142	Physics for Scientists and Engineers II (GT-SC1)			3A	5
Career Development Seminar(s)			X		
Total Credits					17

of Engineers. This new curriculum incorporates skills that engineers need beyond technical expertise, in areas like communication, ethics, social impact and interaction in large, diverse groups. The ECE department requires that students also complete the following three Career Development Seminars: 1) Resume Writing; 2) Behavior Based Interviewing; and 3) Using LinkedIn™.

In order to maintain professional standards required of practicing engineers, the Department of Electrical and Computer Engineering requires a cumulative grade point average of at least 2.000 in Electrical Engineering courses as a graduation requirement. It is the responsibility of any student who fails to maintain a 2.000 average to work with their advisor to correct grade point deficiencies. In addition, ECE courses **required for the major** at the 100, 200, and 300 level must be passed with a minimum grade of C (2.000); grades below a C will require the student to retake the course. ECE courses designated as an elective are exempt from the C or higher minimum grade requirement.

<i>Junior</i>					
Semester 5		Critical	Recommended	AUCC	Credits
CS 253	Software Development with C++	X			4
ECE 311	Linear System Analysis I	X			3
ECE 331	Electronics Principles I	X			4
ECE 450	Digital System Design Laboratory	X			1
ECE 451	Digital System Design	X			3
Career Development Seminar(s)			X		
Total Credits					15
Semester 6		Critical	Recommended	AUCC	Credits
ECE 332	Electronics Principles II	X			4
ECE 452	Computer Organization and Architecture	X			3
ECON 202	Principles of Microeconomics (GT-SS1)		X	3C	3
Select a minimum of three credits from the following:					3
DSCI 369	Linear Algebra for Data Science	X			
MATH 369	Linear Algebra I	X			
Select one course from the following:					3
JTC 300	Strategic Writing and Communication (GT-CO3)		X	2	
CO 301B	Writing in the Disciplines: Sciences (GT-CO3)		X	2	
Career Development Seminar(s)			X		
Total Credits					16
<i>Senior</i>					
Semester 7		Critical	Recommended	AUCC	Credits
ECE 340	Electromagnetics for Computer Engineering	X			3
ECE 401	Senior Design Project I	X		4A,4B	3
Select at least three credits from the following:					3
CS 356	Systems Security	X			
ECE 528/ CS 528	Embedded Systems and Machine Learning	X			
Arts and Humanities (http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities)		X		3B	3
Historical Perspectives (http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#historical-perspectives)		X		3D	3
Career Development Seminar(s)			X		
Total Credits					15
Semester 8		Critical	Recommended	AUCC	Credits
ECE 402	Senior Design Project II	X		4C	3
ECE 456	Computer Networks	X			4
Computer Engineering Electives and Technical Electives (See List on Requirements Tab)		X			7
Arts and Humanities (http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities)		X		3B	3
The benchmark courses for the 8th semester are the remaining courses in the entire program of study.		X			
Total Credits					17
Program Total Credits:					126