

ELECTRICAL & COMPUTER ENGINEERING - PROFESSIONAL MASTER OF SCIENCE (MSECE)

The Professional Master of Science degree in electrical and computer engineering is composed of subplans containing advanced courses relevant to working engineers. These subplans lead to a Master of Science in Electrical and Computer Engineering.

Program Subplans

Embedded Systems Engineering (ESE) Subplan

The Embedded Systems Engineering (<http://www.colorado.edu/ecee/graduate-program/degrees/embedded-systems/>) (ESE) subplan provides comprehensive coverage of essential embedded technologies, current tools and trends. It is structured to provide students with a broad, versatile skill set and is coupled with industry input for continuous curriculum updates.

Through flexible core course options and electives, students enrolled in the ESE subplan pursue a 30-credit-hour degree. Many courses offer distance learning options, though certain courses may be but geographically limited due to supply chain availability and shipping costs for lab kits.

High-Speed Digital Engineering (HSDE) Subplan

The High-Speed Digital Engineering (<https://www.colorado.edu/ecee/academics/graduate-programs/professional-masters/high-speed-digital-engineering/>)(HSDE) subplan is an innovative practical degree plan that prepares students for a career in industry with the specialized knowledge required to be a successful high-speed design engineering team member and to be able to solve complex signal integrity, power integrity and electromagnetic compatibility design problems quickly and efficiently. Simulation and measurement tools used in industry are leveraged to develop and enhance high-speed digital engineering design intuition at the same time fundamental principles are studied through best practices from industry in design, measurement, simulation and analysis. The program facilitates lifelong learning capabilities and is continuously updated with industry input.

Through five core courses and five elective options, students enrolled in this subplan pursue a ten course, 30-credit-hour degree. Most courses emphasize practical, hands-on experience, understanding and solving real world problems faced by the electronics industry today. Students with a background in electrical engineering fundamentals will be well-prepared for this subplan. It is intended for students and engineers with a bachelor's degree in electrical engineering or equivalent, including a background in basic electromagnetics. Students with other relevant engineering or scientific backgrounds may still be admitted to the subplan.

There are no distance course options available for this subplan.

Next-Generation Power and Energy Systems (PPS) Subplan

The Next-Generation Power and Energy Systems ([https://www.colorado.edu/ecee/graduate-program/degrees-programs/next-](https://www.colorado.edu/ecee/graduate-program/degrees-programs/next-generation-power-and-energy-systems/)

[generation-power-and-energy-systems/](https://www.colorado.edu/ecee/graduate-program/degrees-programs/next-generation-power-and-energy-systems/)) (PPS) subplan offers five core courses and numerous electives for the 30-credit hour program to prepare students with the specialized knowledge required to practice grid integration of renewable energy into integrated energy systems, taught by instructors from CU Boulder's faculty and National Renewable Energy Laboratory (NREL) research programs

Through flexible core course options and electives, students enrolled in the PPS subplan pursue the degree.

Many courses offer distance learning options.

Power Electronics (PPE) Subplan

Power Electronics (<http://www.colorado.edu/ecee/graduate-program/degrees/power-electronics-certificate/>) is a key enabling technology in essentially all electronic systems and is increasingly important in the grid interface of renewable energy sources and in efficient electrical loads. The necessity for power electronics technology in these rapidly expanding areas creates an increasing need for design engineers equipped with knowledge and skills to actively participate in multidisciplinary teams.

Through flexible core course options and electives, students enrolled in this subplan pursue a 30-credit-hour degree. The subplan is intended for students and engineers with a BS degree in electrical engineering or the equivalent. Entering students must have adequate knowledge of circuits and electronics, as taught in undergraduate courses intended for EE majors.

Many courses offer distance learning options.

Quantum Engineering (QE) Subplan

Inspired by the promise of more powerful computers and better sensors the global rise in funding for quantum (<https://www.colorado.edu/ecee/academics/graduate-programs/professional-masters/quantum-engineering/>) technology has skyrocketed. This can be evidenced by the investment in several large companies (Google, IBM, Intel and Amazon). The quantum engineering subplan provides a unique overview of one of the fastest-growing technological fields and will help to prepare students for the quantum workforce of today and tomorrow.

The QE subplan provides students with a working knowledge of the principles of quantum mechanics and how they can be implemented in technological areas such as quantum computing, communications and sensing. Through core course options and electives, students enrolled in this subplan pursue a 30-credit-hour degree. The program is intended for students and engineers with a BS degree in STEM with solid knowledge in calculus, linear algebra and probability.

There are no distance course options available for this subplan.

Distance Education Option

Students can take individual courses toward a master's degree or graduate certificate through distance education (online). For more information, connect with the individual graduate program directly.

Requirements

Admission

A minimum undergraduate GPA of 3.00 is required for application to the master's program. Students who are interested in the PhD degree and have strong academics (including 3.50 or higher GPA) should apply directly to the PhD program (<https://catalog.colorado.edu/graduate/>

colleges-schools/engineering-applied-science/programs-study/electrical-engineering/electrical-engineering-doctor-philosophy-phd/).

Course Requirements

The following course requirements are subject to change; for the most current information, visit the ECEE department's Professional Master's Program webpage (<https://www.colorado.edu/ecee/academics/graduate-programs/professional-masters/>). (<https://www.colorado.edu/ecee/academics/graduate-programs/professional-masters/>)

Students must complete a total of 30 course credit hours with a grade of C or better and have a cumulative GPA of at least 3.00. At least 24 credit hours must be completed at the 5000-level or above, and at least 18 of those credits must be in sufficiently technical ECEN 5000+ level courses.

Time Limit

All degree requirements must be completed within four years of the date of commencing coursework. Most students complete the degree in one-and-a-half to two years.

Program Tracks

Embedded Systems Engineering (ESE) Track

Code	Title	Credit Hours
A minimum of 5 ESE core courses (15 credit hours) and 2 ESE elective courses (6 credit hours) from the ESE course list are required.		

ESE Core Courses

Choose five of the following: 15

ECEN 5613	Embedded System Design	
ECEN 5623	Real-Time Embedded Systems	
ECEN 5803	Mastering Embedded Systems Architecture	
ECEN 5813	Principles of Embedded Software	
ECEN 5823	Internet of Things Embedded Firmware	
ECEN 5833	Low Power Embedded Design Techniques	
ECEN 5853	Embedding Sensors and Motors	
ECEN 5863	Programmable Logic Embedded System Design	

ESE Program Electives

Choose two of the following (or additional ESE core courses): 6

ECEN 5713	Advanced Embedded Software Development	
ECEN 5763	Embedded Computer Vision	
ECEN 5133	Fundamentals of Computer Security	
ECEN 5224	High Speed Digital Design	
ECEN 5593	Advanced Computer Architecture	
ECEN 5730	Practical Printed Circuit Board Design and Manufacture	
ECEN 5313	Concurrent Programming	
ECEN 5523	Compiler Construction	
ECEN 5253	Datacenter Scale Computing - Methods, Systems and Techniques	
ECEN 5139	Computer-Aided Verification ¹	

ECEN 5003	Special Topics (Embedded AI (another ECEN 5003 will be Advanced Programmable Logic)) ²	
ECEN 5773	Developing the Industrial Internet of Things ³	
ECEN 5783	Embedded Interface Design ⁴	
Open 5000 Level Electives		9
Choose three 5000-level electives from the ESE core, ESE electives, other ECEE courses, or courses in other departments, with approval of academic advisor.		
Concurrent Programming		
Total Credit Hours		30

¹ Can also optionally take ECEN 5523 Compiler Construction and/or ECEN 5253 Special Topics: Datacenter Scale Computing, when available.

² Embedded AI, potentially in Spring 2027, but remains to be seen Advanced Programmable Logic, not in 2026-27, but in future

³ Not projected to be offered 2026-27, but in future

⁴ Not projected to be offered 2026-27, but in future

For more information, visit the department's Embedded Systems Engineering (<http://www.colorado.edu/ecee/graduate-program/degrees/embedded-systems/>) webpage. (At that page, please click on the "Embedded Systems Engineering Courses (<https://www.colorado.edu/ecee/academics/graduate-programs/professional-masters/embedded-systems-engineering-and-internet-things/#ucb-accordion-id-4-content1>)" button to see particular semesters of course availability).

High-Speed Digital Engineering (HSDE) Track

This program track consists of 10 courses totaling 30 credits. Five of the courses (15 credits) must be the core courses of the curriculum. A minimum of two additional courses (6 credits) must be chosen from the HSDE PMP elective courses list. The remaining three courses (9 credits) may be chosen from the HSDE PMP elective courses list OR from the courses that fulfill general ECEE Master's degree requirements.

A grade of C or better is required for each course applied towards the HSDE PMP track for degree-seeking students.

For HSDE courses taken non-degreeed, and subsequently wanting to transfer maximally 9 credit hours toward a degree, the minimal grade in each course must be a solid B or better.

Code	Title	Credit Hours
HSDE Core Courses		
All five required:		
ECEN 5224	High Speed Digital Design (spring)	3
ECEN 5514	Principles of Electromagnetics for High-Speed Digital Engineering (fall)	3
ECEN 5524	Principles of Computational Electromagnetics for Signal and Power Integrity (spring)	3
ECEN 5534	Signal Integrity Measurements for High Speed Digital Engineering (fall)	3
ECEN 5730	Practical Printed Circuit Board Design and Manufacture (fall, spring)	3
HSDE Program Electives		

Choose one:	3
ECEN 5544 PCB and System Design for Signal Integrity Using Simulations (fall)	
ECEN 5554 Signal Integrity in Memory and Storage Systems (spring)	
<i>Choose your final four courses from the above HSDE electives list, and/or from other STEM (Science, Tech, Engineering, Math) electives</i>	12
Total Credit Hours	30

- For more information, visit the department's High-Speed Digital Engineering (<https://www.colorado.edu/ecee/academics/graduate-programs/professional-masters/high-speed-digital-engineering/>) webpage.

Next-Generation Power and Energy Systems (PPS) Track

Code	Title	Credit Hours
Core Courses		
ECEN 5797	Introduction to Power Electronics	3
ECEN 5407	Renewable Energy and the Future Power Grid (Renewable Energy and the Future Power Grid)	3
ECEN 5417	Power System Analysis (Power Systems Analysis)	3
ECEN 5427	Power System Planning & Operations (Power System Operations & Planning)	3
ECEN 5437	Distribution System Analysis (Distribution System Analysis)	3
Elective Courses		
	Three credit hours of ECEN electives from the following list (one course) plus 12 more credit hours (four courses) of open 5000-level electives, either NGPES elective, other ECEE, or other technical coursework in College of Engineering and Applied Science departments (must be approved by academic advisor). Students may take one nontechnical elective, if approved by academic advisor.	15
AREN 5570	Building Electrical Systems Design 1 (Building Electrical Systems)	
ECEN 5007	Special Topics (Electrified Transportation)	
ECEN 5007	Special Topics (Power System Protection)	
ECEN 5007	Special Topics (High Voltage AC and DC Transmission)	
ECEN 5447	Power System Dynamics with Renewable Energy	
ECEN 5457	Energy Systems Optimization	
ECEN 5467	Data Analytics and Data-Driven Decision Making for Modern Power and Energy Systems	
ECEN 5517	Power Electronics and Photovoltaic Power Systems Laboratory	
ENVM 5005	The Business of Renewable and Sustainable Energy	
Total Credit Hours		30

Power Electronics (PPE) Track

This curriculum is built around a core of three theory courses and two laboratory courses that provide practical laboratory and design experience of specific relevance to the practice of power electronics.

Code	Title	Credit Hours
Required Theory Courses		
ECEN 5797	Introduction to Power Electronics (fall)	3
ECEN 5807	Modeling and Control of Power Electronic Systems (alternate spring)	3
ECEN 5817	Resonant and Soft-Switching Techniques in Power Electronics (alternate spring)	3

Required Laboratory Courses

The degree also requires completion of the following laboratory course in power electronics.

ECEN 5527	Power Electronics Design Laboratory (fall)	3
ECEN 5517	Power Electronics and Photovoltaic Power Systems Laboratory (spring)	3

Electives

Select at least one of the following power electronics electives: 3

Digital Control for Power Electronics

ECEN 5857	Digital Control for Power Electronics (fall)	
-----------	--	--

Electric Vehicles

ECEN 5607	Power Electronics for Electrified Transportation (alternate fall)	
-----------	---	--

Power Management Integrated Circuits

ECEN 5827	Analog IC Design (alternate fall)	
-----------	-----------------------------------	--

Grid Integration of Renewables (variable semesters)

ECEN 5407	Renewable Energy and the Future Power Grid	
ECEN 5417	Power System Analysis	
ECEN 5427	Power System Planning & Operations	
ECEN 5437	Distribution System Analysis	
ECEN 5447	Power System Dynamics with Renewable Energy	
ECEN 5457	Energy Systems Optimization	
ECEN 5467	Data Analytics and Data-Driven Decision Making for Modern Power and Energy Systems	

Technical Electives

Choose up to three technical electives with advisor approval. 9

Open Elective

Choose an additional elective course with advisor approval. 3

Total Credit Hours **30**

For more information, visit the department's Power Electronics (<http://www.colorado.edu/ecee/graduate-program/degrees/power-electronics-certificate/>) webpage.

Quantum Engineering Track

Quantum engineering has a wide variety of hardware platforms to choose from and quantum engineers need a broad range of skills that are more traditional EE topics. To address this diversity and help quantum engineers make informed choices, the program offers a wide range of

options, allowing students to tailor their education to their interests and to the specific demands of the quantum industry.

1-Both of the two **core courses** below are required.

2-Two **quantum electives** are also required (of the four listed below, with the offerings changing semester to semester).

3-Additionally, students may request specific 5000-level (graduate) courses be counted on a case-by-case basis.

Code	Title	Credit Hours
Quantum Core Courses		
ECEN 5915	Foundations of Quantum Engineering	
ECEN 5925	Foundations of Quantum Hardware	
PHYS 7570	Quantum Information and Computing	
	Quantum Metrology & Sensing. (Currently ECEN 5005 Special Topics: Optical & Quantum Metrology)	
Quantum Elective Courses		
	CSCI 7000 Special Topics: Intro Quantum Comp Arch/Sys	
	CSCI 7000 Special Topics: Quantum Complexity and Beyond	
Other Electives		
<i>Electromagnetics / RF Electives</i>		
ECEN 5114	Electromagnetic Theory	
ECEN 5154	Computational Electromagnetics	
ECEN 5634	Microwave and RF Laboratory	
ECEN 5104	Passive Microwave Circuits	
ECEN 5014	Special Topics (Active Microwave Circuits)	
<i>Optics Electives</i>		
ECEN 5156	Physical Optics	
ECEN 5696	Fourier Optics	
ECEN 5645	Introduction to Optical Electronics	
ECEN 5126	Computational Optical Imaging	
ECEN 5616	Optoelectric System Design	
ECEN 6006	Special Topics (Crystal & Nonlinear Optics)	
<i>Embedded Systems Engineering Electives</i>		
ECEN 5623	Real-Time Embedded Systems	
ECEN 5803	Mastering Embedded Systems Architecture	
ECEN 5593	Advanced Computer Architecture	
ECEN 5783	Embedded Interface Design	
ECEN 5863	Programmable Logic Embedded System Design	
<i>Theory Electives</i>		
ECEN 5712	Machine Learning for Engineers	
PHYS 5250	Quantum Theory 1	
PHYS 5260	Quantum Theory 2	
ECEN 5345	Introduction to Solid State Physics	
PHYS 7560	Quantum Optics	

By petition, other STEM (Science, Technology, Engineering, Math) courses will be considered if not explicitly listed.

Learning Outcomes

By the completion of the program, students will be able to:

- Demonstrate the necessary understanding and skillsets with specific kinds of software and hardware in order to perform at a relatively strong level in industry jobs, both for optional industry internships and in post-graduation employment.
- Practice the necessary technical and interpersonal skills to gain meaningful employment within their chosen field of study through university relations with local and national companies and laboratories in addition to career events.
- Demonstrate a deeper, specialized set of technical skills through successful completion of additional, concentrated coursework in a chosen specialty within the field of study.
- Demonstrate the experimental and/or analytical skills essential to a career in their chosen field of study.