

# EMBEDDED SYSTEMS ENGINEERING - GRADUATE CERTIFICATE

Most of us will casually encounter dozens of embedded systems by mid-morning each day throughout our residences, roadways and workplaces. Fundamentally, an embedded system is some combination of hardware and software that is designed for a particular function. It senses a real-world condition, does some computing, then produces output data or control of some kind.

These intelligent machines are a permanent part of our global landscape and are continuously being expanded and upgraded by a world of forward-thinking engineers and entrepreneurs. Application domains include aerospace and defense, energy, industrial automation, medical, networking and communication, security, transportation and more. Also expected to fuel much more growth is an overarching megatrend referred to as the Internet of Things (IoT), which involves connecting more embedded systems to the internet, enabling countless human-to-machine and machine-to-machine applications ranging from home automation to security and many beyond.

Fueled by dramatic reductions in size, cost and power consumption, combined with ever increasing availability of wireless networking technology, the industry estimates that there could be 100 billion connected devices by 2027. Revenue projections for IoT nodes, gateways, platforms, software and services could be as high as \$1,149 billion by 2027. This trend ushers in greater hardware and software design challenges for low-power and effectively managing and securing connected devices, as well as capturing and harnessing vast amounts of data produced by business operations. From whatever perspective students prefer to examine, the magnitude and breadth of opportunities is very clear across a multitude of end markets.

The embedded systems engineering certificate, which is offered by the Department of Electrical, Computer and Energy Engineering, provides students the competitive hardware and software knowledge and skills needed to design and implement these systems.

For more information, visit the department's Embedded Systems Engineering (<http://www.colorado.edu/ecee/graduate-program/degrees/embedded-systems/>) webpage.

## 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

### Application Requirements

Applicants for the certificate program must have been or currently be enrolled for a baccalaureate degree from an accredited institution and have satisfied the prerequisites for each course through coursework or work experience. They need not be enrolled in a degree-granting program at CU Boulder.

Graduate students pursuing an ESE certificate are not required to matriculate into the ESE program subplan through a master's degree.

Admission to a graduate degree-seeking program in the ECEE Department is *not* required for students pursuing only the certificate.

### Program Requirements

The embedded systems engineering (ESE) certificate curriculum consists of two core courses and one elective course from an approved list, totaling at least 9 credit hours. A grade of C or higher is required for each course applied toward the standalone certificate (or, toward a certificate being taken simultaneous to a degree in electrical engineering), along with a cumulative GPA of 3.0 for certificate qualification. A grade of B or higher is required to qualify for transfer from the nondegree to the master's degree program.

ESE certificate credit hours may be applied towards a full master's degree, provided the student is admitted to the electrical engineering graduate program as a degree-seeking student. However, credit hours may not count toward both a bachelor's and a master's degree.

Code	Title	Credit Hours
<b>Core Courses</b>		
Choose two of the following: <sup>1</sup>		6
ECEN 5613	Embedded System Design	
ECEN 5623	Real-Time Embedded Systems	
ECEN 5803	Mastering Embedded Systems Architecture	
<b>Elective</b>		
Choose one course from the approved ESE course list (core or elective). <sup>2</sup>		3
<b>Total Credit Hours</b>		<b>9</b>

<sup>1</sup> Students may complete the certificate by taking all three core courses, rather than taking two core courses and an ESE elective.

<sup>2</sup> Embedded Systems course list (<https://www.colorado.edu/ecee/graduate-program/degrees-programs/professional-masters-programs/embedded-systems/embedded-systems/>).