ELECTRICAL ENGINEERING - PROFESSIONAL MASTER OF SCIENCE (MSEE)

The professional Master of Science degree in electrical engineering is a professional degree composed of advanced courses relevant to working engineers.

The department offers three degree tracks, each of which result in a professional Master of Science degree in electrical engineering (MSEE).

Program Tracks

Embedded Systems Engineering (ESE) Track
The Embedded Systems Engineering (http://www.colorado.edu/ecee/graduate-program/degrees/embedded-systems) (ESE) track 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 program pursue a 30-credit-hour MSEE degree. Many courses offer distance learning options through CU Boulder Connect.

Power Electronics (PPE) Track
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 program pursue a 30-credit-hour MSEE degree. The program 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.

Photonics (PHO) Track
While 20th-century technology was defined by the growth of electronics, the 21st century belongs to photonics (https://www.colorado.edu/ecee/graduate-program/degrees/photonics). LEDs will light households powered by photovoltaic panels and filled with displays and cameras communicating by optical fiber to distant owners wearing virtual reality glasses. Laser 3D printing will transform manufacturing. New microscopes and telescopes will peer into the depths of living cells and distant galaxies. Photonics graduates will command skills in design, fabrication and laboratory practice to place them at the forefront of these industries and many more not yet invented.

Photonics is the electrical engineering sub-discipline concerned with the generation, modulation, radiative or guided transmission, sensing and detection of optical-frequency signals. Application areas include optical telecommunications, medical instrumentation, photovoltaic power generation, quantum information processing, optical instruments and environmental sensing. While some of these industries are mature, photonics continues to rapidly grow into new industries such as LED lighting and on-chip silicon photonics for multi-core CPUs.

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

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.

Coursera Option
This program is also available as a completely online master’s degree (https://www.colorado.edu/ecee/msee) through Coursera.

Requirements

Entry:
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 (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 department’s Embedded Systems Engineering (http://www.colorado.edu/ecee/graduate-program/degrees/embedded-systems), Power Electronics (http://www.colorado.edu/ecee/graduate-program/degrees/power-electronics-certificate) or Photonics (https://www.colorado.edu/ecee/graduate-program/degrees/photonics) webpages.

Students must complete a total of 30 credit hours (including both course and thesis hours) with a grade of C or better and 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 courses.

Program Tracks

Embedded Systems Engineering (ESE) Track (non-thesis)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESE Core Courses</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Choose five of the following:</td>
<td></td>
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<tr>
<td>ECEN 5023</td>
<td>Special Topics (Low Power Embedded Design Techniques)</td>
<td></td>
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<tr>
<td>ECEN 5053</td>
<td>Special Topics (Embedding Sensors and Actuators)</td>
<td></td>
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<tr>
<td>ECEN 5613</td>
<td>Embedded System Design</td>
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<tr>
<td>ECEN 5623</td>
<td>Real-Time Embedded Systems</td>
<td></td>
</tr>
<tr>
<td>ECEN 5803</td>
<td>Mastering Embedded Systems Architecture</td>
<td></td>
</tr>
<tr>
<td>ECEN 5813</td>
<td>Principles of Embedded Software (Low Power Embedded Design Techniques)</td>
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</tbody>
</table>
Electrical Engineering - Professional Master of Science (MSEE)

ECEN 5823  Internet of Things Embedded Firmware (IoT Embedded Firmware)

ECEN 5863  Programmable Logic Embedded System Design

ESE Program Electives
Choose two of the following (or additional ESE courses): 6
ECEN 5013  Special Topics (Advanced Embedded Software Development)
ECEN 5013  Special Topics (ASIP and IP Core Processor Design)
ECEN 5013  Special Topics (Practical PCB Design and Manufacture / Accelerator)
ECEN 5023  Special Topics (Soft Processor Design for FPGA)
ECEN 4/5033  Introduction to Computer Security
ECEN 5053  Special Topics (Embedded Interface Design)
ECEN 4/5224  High Speed Digital Design
ECEN 5593  Advanced Computer Architecture
ECEN 5763  Embedded Machine Vision and Intelligent Automation

Open 5000 Level Electives
Choose three 5000-level electives from the ESE core, ESE electives, other ECEE courses, or courses in other departments, with approval of academic advisor. 9

Total Credit Hours 30

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

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.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECEN 5797</td>
<td>Introduction to Power Electronics</td>
<td>3</td>
</tr>
<tr>
<td>ECEN 5807</td>
<td>Modeling and Control of Power Electronic Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECEN 5817</td>
<td>Resonant and Soft-Switching Techniques in Power Electronics</td>
<td>3</td>
</tr>
</tbody>
</table>

Required Laboratory Courses
ECEN 5517  Power Electronics and Photovoltaic Power Systems Laboratory
ECEN 5XXX  Select one 5000-level project laboratory in power electronics (offered every fall)

Electives
Select one of the following power electronics electives: 3
Electric Vehicles
ECEN 5017  Power Electronics for Electric Drivetrain Vehicles; fall
ECEN 5737  Adjustable-Speed AC Drives (spring)
Analog and Mixed-Signal IC Design
ECEN 5827  Analog IC Design (fall)

ECEN 5837  Mixed-Signal IC Design Lab (alternate spring semesters)
ECEN 5XX8  Integrated Circuits and Devices for Power Electronics (alternate spring semesters)

Grid Integration of Renewables
ECEN 5XX7  Control of Power Electronics in AC Systems and Micrograms
ECEN 5XX7  Renewable Energy and the Future Power Grid
ECEN 5XX7  Advances in Control and Optimization of Power Systems
ECEN 5XX7  Power System Analysis

Technical Electives
Choose three technical electives with advisor approval. 9
Recommended electives include courses in control systems, RF/microwaves and engineering management.

Open Elective
Choose an additional elective course. 3
Total Credit Hours 27

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

Photonics (PHO) Track

<table>
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<th>Code</th>
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</table>
| PHO core courses
  Offered in Fall:
  ECEN 5156  Physical Optics                             | 3            |
  ECEN 5696  Fourier Optics                              | 3            |
  ECEN 5345  Introduction to Solid State Physics         | 3            |
  Offered in Spring:
  ECEN 5616  Optoelectric System Design                  | 3            |
  ECEN 5606  Optics Laboratory                           | 3            |
  ECEN 5626  Active Optical Devices                      | 3            |
  ECEN 5355  Principles of Electronic Devices 1           | 3            |

PHO elective courses
Offered in variable semesters
ECEN 6006
ECEN 5016  Special Topics (Quantum Mechanics)             | 3            |
ECEN 5005  Special Topics (Photovoltaic Devices)           | 3            |
ECEN 5015
ECEN 5031
ECEN 5026

For more information, visit the department’s Photonics (https://www.colorado.edu/ecee/graduate-program/degrees/photonics) webpage.

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.