

ELECTRICAL ENGINEERING, MSE

The MSE Program in Electrical Engineering gives students the theoretical and technological foundation needed to deal with the new ideas and new applications that are the hallmarks of modern electrical engineering. A major advantage of our MSE program is that it allows students to focus their education according to their interests and goals, from nanotechnology and circuits, to embedded systems or robotics. The MSE Program in Electrical Engineering gives students the theoretical foundation and the interdisciplinary skills needed to deal with the new ideas and new applications that are the hallmarks of modern electroscience. A major advantage of our MSE Program allows you to tailor your education to your own interests and goals, from Electromagnetics and Photonics, sensors and MEMS to VLSI and Nanotechnology.

For more information: <http://www.ese.upenn.edu/current-students/masters/index.php> (<http://www.ese.upenn.edu/current-students/masters/>)

Electrical Engineering Degree Requirements

10 course units are required for MSE in Electrical Engineering.¹

Code	Title	Course Units
EE Core		
Select 5 required course units in any of the three areas below: ²		5
<i>Physical Devices and Nano Systems</i>		
ESE 5090	Quantum Circuits and Systems	
ESE 5100	Electromagnetic and Optics	
ESE 5130	Prin of Quantum Tech	
ESE 5210	The Physics of Solid State Energy Devices	
ESE 5230	Quantum Engineering	
ESE 5250	Nanoscale Science and Engineering	
ESE 5290	Introduction to Micro- and Nano-electromechanical Technologies	
ESE 5360	Nanofabrication and Nanocharacterization	
<i>Circuits and Computer Engineering</i>		
ESE 5150	Internet of Things Sensors and Systems	
ESE 5160	IoT Edge Computing	
ESE 5190	Smart Devices	
ESE 5320	System-on-a-Chip Architecture	
ESE 5350	Electronic Design Automation	
ESE 5390	Hardware/Software Co-Design for Machine Learning	
ESE 5700	Digital Integrated Circuits and VLSI-Fundamentals	
ESE 5720	Analog Integrated Circuits	
ESE 5730	Chips-design	
ESE 5780	RFIC (Radio Frequency Integrated Circuit) Design	
ESE 5800	Power Electronics	

ESE 6680	Mixed Signal Circuit Design and Modeling	
<i>Information and Decision Systems</i>		
ESE 5000	Linear Systems Theory	
ESE 5030	Simulation Modeling and Analysis	
ESE 5050	Feedback Control Design and Analysis	
ESE 5060	Introduction to Optimization Theory	
ESE 5070	Introduction to Networks and Protocols	
ESE 5120	Dynamical Systems for Engineering and Biological Applications	
ESE 5140	Graph Neural Networks	
ESE 5280	Estimation and Detection Theory	
ESE 5300	Elements of Probability Theory	
ESE 5310	Digital Signal Processing	
ESE 5380	Machine Learning for Time-Series Data	
ESE 5420	Statistics for Data Science	
ESE 5450	Data Mining: Learning from Massive Datasets	
ESE 5460	Principles of Deep Learning	
ESE Electives		
Select 2 ESE electives ³		2
SEAS Electives		
Select 1 SEAS elective ^{4,5}		1
Open Electives		
Select 2 open electives ⁶		2
Total Course Units		10

¹ Students must complete ten (10) course units at the graduate level (5000+).

- A maximum of two (2) graduate-level course units may be transferred from another school to apply towards the degree. These cannot have been used to fulfill requirements of an undergraduate degree.
- Students must be registered with the 5000-level course number to be eligible as a graduate level course. Any cross-listed section at the 4000-level or below is ineligible towards the degree.

² Students can select any combination from this list, and are not limited to a single area.

³ Select any graduate-level ESE course at the 5000 and 6000 level.

⁴ Select 1 graduate-level course within: ESE, CIS, CIT, IPD, MEAM, EAS, or ENM. A maximum of two (2) CIT course units are allowed towards the degree.

⁵ Only the following EAS courses are allowed:

- EAS 5070 Intellectual Property and Business Law for Engineers
- EAS 5100 Technical Communication and Academic Writing for Non-native Speakers of English
- EAS 5120 Engineering Negotiation
- EAS 5450 Engineering Entrepreneurship I
- EAS 5460 Engineering Entrepreneurship II
- EAS 5950 Foundations of Leadership
- ESE 6800 Special Topics in Electrical and Systems Engineering can be taken several times and counted more than once towards the degree. Each ESE 6800 Special Topics in Electrical and Systems Engineering course taken must address different topics to be eligible.

- A maximum of 1 ESE 5990 course unit can be used toward the degree.
- If a thesis is completed, it will count for 2 course units of ESE 5970 Master's Thesis).

⁶ Select from graduate courses at Penn in SEAS, SAS, Medicine, Law, Wharton MBA, Social Policy, and Education. These must have technical/scientific content and relevance to the student's program. Approval must be obtained from the ESE department prior to enrollment in the course.

The degree and major requirements displayed are intended as a guide for students entering in the Fall of 2024 and later. Students should consult with their academic program regarding final certifications and requirements for graduation.
