

# ELECTRICAL ENGINEERING (ENGINEERING)

<b>Graduate Program Head</b>	Madhavan Swaminathan
<b>Program Code</b>	EE
<b>Campus(es)</b>	University Park (Ph.D., M.S.)
<b>Degrees Conferred</b>	Doctor of Philosophy (Ph.D.) Master of Science (M.S.) Dual-Title Ph.D. and M.S. in Electrical Engineering and Operations Research
<b>The Graduate Faculty</b>	View ( <a href="https://secure.gradsch.psu.edu/gpms/?searchType=fac&amp;prog=EE">https://secure.gradsch.psu.edu/gpms/?searchType=fac&amp;prog=EE</a> )

The general areas of graduate research in Electrical Engineering are electromagnetics and optics; electronics and photonics; communications, computers, networking, and signal processing; and control and power systems. Specializations available within these areas include:

- microwaves, antennas, and propagation;
- electro-optics and nonlinear optics;
- remote sensing and space systems;
- materials and devices;
- circuits and networks;
- VLSI;
- communications;
- networking;
- signal and image processing;
- computer vision and pattern recognition;
- control systems; and
- power systems.

## Admission Requirements

Applicants apply for admission to the program via the Graduate School application for admission (<https://gradschool.psu.edu/graduate-admissions/how-to-apply/>). Requirements listed here are in addition to Graduate Council policies listed under GCAC-300 Admissions Policies (<https://gradschool.psu.edu/graduate-education-policies/>).

Applicants are required to submit:

- GRE scores are optional (those choosing to submit GRE scores should submit to school code 2660),
- three letters of reference,
- a personal statement of relevant experience and goals,
- a resume,
- official transcripts from all post-secondary institutions attended (<http://www.gradschool.psu.edu/prospective-students/how-to-apply/new-applicants/requirements-for-graduate-admission/>),
- and a supplemental application.

## Degree Requirements Master of Science (M.S.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Policies. (<https://gradschool.psu.edu/graduate-education-policies/>)

1. Thesis option—a total of 32 credits (at least 18 at the 500-and 600-level combined) including:
  - a. 24 credits in course work, with at least 12 credits in courses with the EE designation;
  - b. 2 colloquium credits (EE 500);
  - c. 6 thesis credits (EE 600 or EE 610);
  - d. and a thesis accepted by the advisers and/or committee members, the head of the graduate program, and the Graduate School;
2. Paper option—a total of 32 credits (at least 18 at the 500-level) including:
  - a. 27 credits in course work, with at least 14 credits in courses with the EE designation;
  - b. 2 colloquium credits (EE 500);
  - c. 3 paper credits (EE 594);
  - d. and a satisfactory scholarly paper.

## Doctor of Philosophy (Ph.D.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Policies. (<https://gradschool.psu.edu/graduate-education-policies/>)

The communication requirement is met by adequacy in both spoken and written English. This is accomplished through testing and remedial course requirements. All doctoral students must pass a qualifying examination, a comprehensive examination, and a final oral examination. To earn the Ph.D. degree, doctoral students must also write a dissertation that is accepted by the Ph.D. committee, the head of the graduate program, and the Graduate School. The qualifying examination consists of both written and oral parts; the oral comprehensive examination is preceded by the writing of a dissertation proposal. The program requires a minimum of 39 course credits and 2 colloquium credits (EE 500) beyond the B.S. degree.

## Dual-Titles

### Dual-title Ph.D. and M.S. in Electrical Engineering and Operations Research

Requirements listed here are in addition to requirements listed in GCAC-208 Dual-Title Graduate Degree Programs (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-208-dual-titles/>).

### Admission Requirements

Students must apply and be admitted to the graduate program in Electrical Engineering and The Graduate School before they can apply for admission to the dual-title degree program. After admission to their primary program, students must apply for admission to and meet the admissions requirements of the Operations Research dual-title program. Refer to the Admission Requirements section of the Operations Research Bulletin page (<http://bulletins.psu.edu/graduate/programs/majors/operations-research/>). Doctoral students must be admitted into the dual-

title degree program in Operations Research prior to taking the qualifying examination in their primary graduate program.

### Degree Requirements

To qualify for the dual-title degree, students must satisfy the degree requirements for the degree they are enrolled in Electrical Engineering, listed in the Degree Requirements section. In addition, students must complete the degree requirements for the dual-title in Operations Research, listed on the Operations Research Bulletin page (<http://bulletins.psu.edu/graduate/programs/majors/operations-research/>).

The qualifying examination committee for the dual-title Ph.D. degree will be composed of Graduate Faculty from Electrical Engineering and must include at least one Graduate Faculty member from the Operations Research program. Faculty members who hold appointments in both programs' Graduate Faculty may serve in a combined role. There will be a single qualifying examination, containing elements of both Electrical Engineering and Operations Research. Dual-title graduate degree students may require an additional semester to fulfill requirements for both areas of study and, therefore, the qualifying examination may be delayed one semester beyond the normal period allowable.

In addition to the general Graduate Council requirements for Ph.D. committees (<http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/phd-dissertation-committee-formation/>), the Ph.D. committee of an Electrical Engineering and Operations Research dual-title Ph.D. student must include at least one member of the Operations Research Graduate Faculty. Faculty members who hold appointments in both programs' Graduate Faculty may serve in a combined role. If the chair of the Ph.D. committee is not also a member of the Graduate Faculty in Operations Research, the member of the committee representing Operations Research must be appointed as co-chair. The Operations Research representative on the student's Ph.D. committee will develop questions for and participate in the evaluation of the comprehensive examination.

Students in the dual-title program are required to write and orally defend a dissertation on a topic that is approved in advance by their Ph.D. committee and reflects their original research and education in Electrical Engineering and Operations Research. Upon completion of the doctoral dissertation, the candidate must pass a final oral examination (the dissertation defense) to earn the Ph.D. degree. The dissertation must be accepted by the Ph.D. committee, the head of the graduate program, and the Graduate School.

### Minor

A graduate minor is available in any approved graduate major or dual-title program. The default requirements for a graduate minor are stated in Graduate Council policies listed under GCAC-600 Research Degree Policies (<https://gradschool.psu.edu/graduate-education-policies/>) and GCAC-700 Professional Degree Policies (<https://gradschool.psu.edu/graduate-education-policies/>), depending on the type of degree the student is pursuing:

- GCAC-611 Minor - Research Doctorate (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-611-minor-research-doctorate/>)
- GCAC-641 Minor - Research Master's (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-641-minor-research-masters/>)

- GCAC-709 Minor - Professional Doctorate (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-709-professional-doctoral-minor/>)
- GCAC-741 Minor - Professional Master's (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-741-masters-minor-professional/>)

## Student Aid

Graduate assistantships available to students in this program and other forms of student aid are described in the Tuition & Funding (<https://gradschool.psu.edu/graduate-funding/>) section of The Graduate School's website. Students on graduate assistantships must adhere to the course load limits (<https://gradschool.psu.edu/graduate-education-policies/gsad/gsad-900/gsad-901-graduate-assistants/>) set by The Graduate School.

In addition, the following awards typically have been available to graduate students in this program:

Paul F. Anderson Graduate Fellowship  
 Melvin P. Bloom Memorial Graduate Fellowship  
 Luther B. and Patricia A. Brown Graduate Fellowship  
 Joseph R. and Janice M. Monkowski Graduate Fellowship  
 James R. and Barbara R. Palmer Fellowship  
 Pontano Family Scholarship in Electrical Engineering  
 Society of Penn State Electrical Engineers (SPSEE) Graduate Fellowship  
 Fred C. and M. Joan Thompson Graduate Fellowship  
 Bess L. and Mylan R. Watkins Graduate Fellowship

## Courses

Graduate courses carry numbers from 500 to 699 and 800 to 899. Advanced undergraduate courses numbered between 400 and 499 may be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level may not. A graduate student may register for or audit these courses in order to make up deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

Electrical Engineering (EE) Course List (<https://bulletins.psu.edu/university-course-descriptions/graduate/ee/>)

## Contact

<b>Campus</b>	University Park
<b>Graduate Program Head</b>	Madhavan Swaminathan
<b>Director of Graduate Studies (DGS) or Professor-in-Charge (PIC)</b>	John F. Doherty
<b>Program Contact</b>	Lisa Marie Timko 121 E E East University Park PA 16802 lmg183@psu.edu (814) 863-7294
<b>Program Website</b>	View ( <a href="http://www.eecs.psu.edu/students/graduate/Graduate-Degree-Programs-EE.aspx">http://www.eecs.psu.edu/students/graduate/Graduate-Degree-Programs-EE.aspx</a> )