# COMPUTER ENGINEERING, PHD

**Degree:** Doctor of Philosophy (PhD)
**Field of Study:** Computer Engineering

## Admission

Requirements for admission include a strong record of scholarship in a completed bachelor's degree program in a field of engineering, mathematical or physical sciences, and fluency in written and spoken English. The University requires all foreign applicants to show English proficiency by achieving a TOEFL score of at least 577 on the paper-based exam or 90 on the internet-based exam. Submission of GRE scores for graduate applications is NOT required. Applications from students with a bachelor's degree in fields other than those listed above may be granted admission on a provisional basis. Such provisional students may be advanced to full standing upon completion of prerequisite conditions stipulated in the letter of admission.

## Registration

Course registration is performed through the Student Information System (SIS). Each semester before registration, students should update any personal information that may have changed by logging into SIS and editing the appropriate information. All registration holds must be lifted in order to successfully complete the registration process.

## Advising

Upon admission to the graduate program, each graduate student is assigned an academic advisor to assist in registration as well as planning a program of study (Academic Program). This is a temporary assignment made by the Department Chairperson based on the student's academic and research interests as identified at the time of application.

During the first two semesters in the program, it is strongly suggested that each student meet with various members of faculty to discuss academic objectives/goals and research opportunities. In order to complete the research component of their respective degree program, each student must identify a faculty member who is willing to serve as the student's research advisor. The research advisor will also serve as the student's permanent academic advisor if they are a primary member of the department faculty. If, however, the research advisor is not a primary member of the department faculty, the student is required to find a permanent academic advisor from the department faculty. For students enrolled in the PhD program, the research advisor is commonly known as the "dissertation" advisor.

Each student is required to file an Academic Program, which must be approved by the student's advisor and the Department Chairperson, and submitted to the Dean of Graduate Studies. Full-time PhD students should choose a research advisor and file an Academic Program before taking the qualifier but no later than the beginning of the third semester. Upon passing the qualifier, full-time PhD students will be required to assemble the dissertation guidance committee, prepare a dissertation proposal, and present this proposal to the committee for their approval. This process should be completed within one semester of passing the PhD qualifier.

The student shall be responsible for forming a dissertation guidance committee of at least four members, which shall consist of the student's academic advisor and additional faculty members recommended by the advisor. For the PhD program, the minimum number of additional faculty members on the dissertation guidance committee is three, and at least two of the committee members must be primary faculty within the ECSE program areas (Computer Engineering, Electrical Engineering, and Systems and Control Engineering). The chairperson of the dissertation guidance committee is normally the candidate's research advisor.

Students may change advisors for a variety of reasons of which one of the most common is a change of the student's field of interest. It should be noted that a change in research advisor may require that the student start a new research project, which could result in delaying graduation. It is the responsibility of the student to inform the ECSE Office of Student Affairs in the event of a change in advisor.

## Appeals

Any decision by an academic advisor, dissertation guidance committee or Department Associate Chairperson may be appealed, in writing, to the Department Associate Chairperson who shall present the appeal, with their recommendations, to the faculty at its next regular faculty meeting. The faculty's decision shall be final.

## PhD Degree Program

In order to successfully complete the PhD Degree Program, a student must satisfy the following requirements:

- Fulfill all PhD course requirements in the chosen major area (see individual degree requirements below)
- Have an approved Program of Study and complete the CWRU courses in the approved Program of Study with a cumulative grade point average of 3.25 or greater
- Successfully complete the PhD Qualifying Examination
- Successfully complete the PhD Proposal Defense
- Successfully complete and defend the PhD Dissertation
- Fulfill the PhD residency requirement

### PhD Candidacy

The final consideration of whether to admit the student to PhD candidacy will be taken by the student's dissertation guidance committee after the student has passed the PhD Qualifier. A written report on the results of the qualifier and PhD candidacy will be prepared by the committee and submitted to the Department Chairperson, who, in turn, will notify the School of Graduate Studies of the results.

### PhD Proposal

After passing the Qualifier and being admitted to PhD candidacy, the PhD candidate is required to pass a Dissertation Proposal Exam on a timely basis, generally within one semester after being admitted to candidacy. This exam shall be administered by the student's dissertation guidance committee and consists of a written dissertation proposal and an oral presentation of the proposed dissertation research. As part of the oral presentation, the student will be expected to answer questions covering the proposed research as well as questions on related topics as deemed appropriate by the student's dissertation guidance committee. The written dissertation proposal must be received by the committee members at least ten days before the date scheduled for the oral exam and presentation. The Dissertation Proposal Exam, the PhD research, the final oral dissertation defense, and all other requirements in the student's

PhD program of study must be completed within five years after the student is admitted to PhD candidacy.

### The PhD Oral Defense

The student shall provide an announcement containing a title, abstract, date, time and location of the defense to the ECSE Office of Student Affairs for general distribution at least 10 days in advance of the thesis defense.

### The PhD Residency Requirements

All PhD students shall fulfill the PhD residency requirements set forth by the Case School of Engineering and the **School of Graduate Studies**. Specifically, the PhD student is required either to register for at least 9 credit hours during each of two consecutive semesters or to engage in academic work (taking courses, assisting in course development and/or teaching, fully engaging in research, or some other scholarly activities) in at least six consecutive terms (fall, spring, or summer) between matriculation and a period not exceeding 5 years after the first credited hour of ECSE 701. The period during a leave of absence cannot be counted to fulfill the residency requirement.

## PhD Policies

For PhD policies and procedures, please review the **School of Graduate Studies** section of the General Bulletin.

## Program Requirements

### Course Requirements and Academic Program

Each Computer Engineering PhD student is required to have an Academic Program, approved by the academic advisor, Department Chairperson, and Dean of Graduate Studies, that includes a minimum of 36 credit hours of coursework beyond the BS degree. At least 18 credit hours of coursework must be taken at CWRU. In addition, the student is also required to complete a minimum of 18 credit hours of ECSE 701 to fulfill the requirement for PhD-level research. Acceptable courses include suitable CWRU courses at the 400-level or higher and approved graduate-level courses taken at other institutions. Students holding an MS degree in an appropriate field of study from CWRU or another degree-granting institution may apply up to 18 credit hours of coursework completed for their MS degree towards the aforementioned 36 credit hour requirement.

Each PhD student is required to have a fully-approved Academic Program before taking the PhD Qualifying examination and before registering for the final 18 credit hours of the program. The Academic Program shall be prepared by the student and approved by the research advisor or the permanent academic advisor in the case where the research advisor is not in the Department.

An Academic Program must meet the following requirements:

- A minimum of two courses in mathematics, statistics, or basic science.
- At least six approved courses from the student's major area of study. At least 4 of these courses must be from within the ECSE department.
- Four additional courses that are not listed under the student's major program area. These courses should satisfy the requirement for breadth in the student's program of study.
- A minimum of 18 credit hours of PhD Dissertation research as noted by enrollment in and successful completion of ECSE 701
- Successful completion of ECSE 400T, ECSE 500T and ECSE 600T.
- Successful completion of the ECSE 500 requirement (see below)

The above represents the minimum course requirements beyond the BS degree. The total number of 3 credit hour courses in the Academic Program is at least 12 credit hours beyond the BS level. The selection of these courses should be done with guidance from the student's permanent academic advisor. Any additional courses may be in any one of the above categories as approved by the student's advisor.

#### ECSE Colloquium and Presentation Requirement

The PhD program includes a colloquium and public presentation requirement.

1. All PhD students are required to register for and pass ECSE 500 for a total of **three semesters** of the PhD Program, and this is expected before Advancement to Candidacy. This is a 0 credit hour required course. Students, such as part-time students working in industry, may propose an alternative arrangement for fulfilling this requirement, by submitting a written petition to the Graduate Studies Committee.
2. All PhD students must give **a public presentation** of their research, in addition to their PhD dissertation defense. This presentation must be given either at a research conference, in the ECSE seminar series, workshop presentations or similar presentations in a public venue. MS thesis and PhD dissertation defenses cannot be used to fulfill the public presentation requirement.

Additional details and the associated forms can be acquired from the ECSE Office of Student Affairs.

#### PhD Qualifying Examination

A student shall be admitted to PhD candidacy only after they have passed the PhD Qualifying Examination. The Qualifying Exam is intended to test the students' knowledge in the student's chosen major program area of Computer Engineering. The objectives of the exam are:

1. To assess the PhD student's understanding of the fundamental concepts in Computer Engineering as embodied in the respective graduate curriculum.
2. To ensure that the student have the ability to pursue PhD level research, and have mastered the graduate level coursework necessary to succeed as researchers

Full-time PhD students are recommended to take the PhD qualifier before the beginning of their third semester of full-time (or equivalent) enrollment, and must pass the exam within two years of being admitted to the program. For part-time students, the Qualifying Exam must be passed before more than 27 credit hours of coursework have been completed. For students who must take remedial courses to make up for shortcomings in their engineering and mathematics knowledge base, the deadline can be extended to the fifth semester of full-time (or equivalent) enrollment, but this requires a petition to the ECSE Graduate Committee. Students have two opportunities to pass the PhD Qualifier. A student who fails to pass the Qualifier after two attempts will not be allowed to continue in the PhD program in the Department of Electrical, Computer, and Systems Engineering.

To pass the PhD Qualifier, the student must demonstrate proficiency in two parts:

***Part 1: Computer Engineering***

Part 1 of the PhD Qualifier will consist of a written examination with questions drawn from several course areas listed below. At least three

topic areas must be pursued by the student for a complete qualifier. The exam style is a mini-project oriented, take home test that must be completed within a one week period.

| Code | Title | Credit Hours |
|---|---|---|
| ECSE 315 | Digital Systems Design | 4 |
| ECSE 401 | Digital Signal Processing | 3 |
| ECSE 419 | Computer System Architecture | 3 |
| ECSE 485 | VLSI Systems | 3 |
| ECSE 488 | Embedded Systems Design | 3 |
| CSDS 425 | Computer Networks I | 3 |

Additional topic areas may be assigned depending on the student interests and recommendations from their advisors.

If a student fails all three areas of the written examination, the entire exam must be taken again. If a student fails some areas, the faculty may elect to give another exam to the student in just the areas failed.

The written part of the Qualifying Exam for Computer Engineering will be offered at least once a year at the end of the spring semester.

***Part 2: Computer Engineering***

Part 2 will consist of an oral exam based on the areas of the written examination. However, the oral exam may be waived if the student has performed well in all three topic areas of the written exam.