SYSTEMS AND CONTROL ENGINEERING, PHD

Degree: Doctor of Philosophy (PhD)
Field of Study: Systems and Control 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. It is required that all students submit original copies of GRE scores. 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 member of the department faculty. If, however, the research advisor is not a 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 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 must be 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 Requirements
In order to successfully complete the PhD Degree Program, a student must satisfy the following requirements:

- Select a major dissertation subject area in Electrical Engineering, Computer Engineering, or Systems and Control Engineering
- 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 PhD Qualifying Committee (for Electrical Engineering and Computer Engineering students) or the student’s dissertation guidance committee (for Systems and Control Engineering students) 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
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 hours of PhD Dissertation research as noted by enrollment in and successful completion of ECSE 701 Dissertation Ph.D.
- Successful completion of ECSE 400T Graduate Teaching I, ECSE 500T Graduate Teaching II and ECSE 600T Graduate Teaching III.
- Successful completion of the ECSE 500 ECSE Colloquium 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 twelve (12) 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.

- **a.** All PhD students are required to register for and pass ECSE 500 ECSE Colloquium 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.
- **b.** 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 Systems and Control Engineering. The objectives of the exam are:

- To assess the PhD student’s understanding of the fundamental concepts in Systems and Control Engineering as embodied in the respective graduate curriculum.
- 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: Systems and Control Engineering**

Students must show competency in control systems engineering, signals and systems, and systems analysis (optimization, simulation, stochastic modeling, and decision and economic analysis). Students must demonstrate proficiency in at least three of the following areas:

<table>
<thead>
<tr>
<th>Control Systems</th>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>ECSE 304</td>
<td>Control Engineering I with Laboratory</td>
<td>3</td>
<td></td>
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<tr>
<td>ECSE 408</td>
<td>Introduction to Linear Systems</td>
<td>3</td>
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<tr>
<th>Optimization</th>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tr>
<td>ECSE 346</td>
<td>Engineering Optimization</td>
<td>3</td>
<td></td>
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<tr>
<td>ECSE 416</td>
<td>Convex Optimization for Engineering</td>
<td>3</td>
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<thead>
<tr>
<th>Signal Processing</th>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSE 313</td>
<td>Signal Processing</td>
<td>3</td>
<td></td>
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<tr>
<td>ECSE 401</td>
<td>Digital Signal Processing</td>
<td>3</td>
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<tr>
<th>Simulation and Discrete Event Systems</th>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>ECSE 324</td>
<td>Modeling and Simulation of Continuous Dynamical Systems</td>
<td>3</td>
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<tr>
<th>Stochastic Models and Decisions</th>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>ECSE 352</td>
<td>Engineering Economics and Decision Analysis</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ECSE 452</td>
<td>Random Signals</td>
<td>3</td>
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To demonstrate proficiency in an area, the student can either take one of the courses listed for that area and obtain a course grade of A or take and pass an exam for that specific area. Upon recommendation by the faculty, the student showing marginal proficiency in any area may be required to improve proficiency by serving as a teaching assistant of an appropriate course.

**Part 2: Systems and Control Engineering**

A typical exam begins with a selection by the student’s dissertation guidance committee of 5-6 research articles relevant to the student’s research area. The students will be given 4 weeks to write a report answering questions formulated from those papers by the dissertation guidance committee. This will be followed within one week by an oral exam during which the student will give an oral presentation based on the report and answer questions from the dissertation guidance committee and other attending ECSE faculty. Questions will be based on the report as well as miscellaneous questions on advanced topics in Systems and Control Engineering as deemed appropriate by committee members and/or other attending faculty.