



## Qualifying Examination for Admission to the Ph.D. Programs Effective for students entering Fall 2017 or after

Students may apply for admission to the Ph.D. program in Industrial Engineering or Systems and Entrepreneurial Engineering upon receiving a B.S. degree or an M.S. degree in engineering or related discipline. In general, students entering the program with a B.S. degree should take the Qualifying Examination (the Qual) before obtaining the M.S. degree. Students entering the Ph.D. program with a B.S. degree are encouraged to take their qualifying examinations no later than the **fifth semester** after beginning their graduate study. Students entering the Ph.D. program with a M.S. degree should take their qualifying examinations no later than their **third semester** of enrollment. Students will sign up for the qualifying exam in May for the following fall semester's exam. If a student is admitted in the spring semester, the student may petition to take the qualifying exam for the first time off-cycle (during the spring semester).

The Ph.D. degree requirements in Industrial Engineering and Systems and Entrepreneurial Engineering are structured to assure depth in the student's area of research, and at the same time, to assure breadth in engineering. Admission to Ph.D. candidacy is based on the faculty's evaluation of the student's research potential, scholastic competence as evidenced by grades, and satisfactory performance on the Qual.

To be permitted to take the Qual all students must meet the following requirements:

1. A signed MS/PhD Advisor Agreement Form must be on file in the ISE Graduate Department office.
2. 8 credit hours of 500-level coursework must be completed in IE and/or SE courses, other than the thesis credit courses (IE or SE 599).
3. A grade point average of at least 3.25 must have been attained on all graduate coursework completed.

The Qual has two components. The first component consists of a written-exam; the oral-examination forms the second component. The written exam involves three parts. Each part will be a one hour-long examination on topics covered in the courses listed below. The variations in the choice-structure within each research concentration are explained. The written exam will be held within three weeks of the start of each semester. This exam is open note, open book. Students may not bring calculators, cell phones, computers, tablets, or other electronic devices. A calculator will be provided.

A student who fails any portion of the Qual may repeat that portion of the exam in the subsequent semester. A student who fails the exam on the second attempt will not be allowed to continue in the Ph.D. program. A student who fails two or three of the one-hour written exams will not be allowed to take the oral qualifying exam until the following semester.

### ISE Written Qualifying Examination

The ISE written qualifying exam will consist of three one-hour written examinations. Each one-hour portion will cover material from 1 of 3 courses. These exams will be graded as "pass/borderline/fail". The PhD candidate's advisor can view the graded exam, but the exam will not be made available to the student. The faculty will ratify the results of the written qualifying exam at the monthly meeting following

the written exam. A student who is “borderline” on a written exam can be provided a conditional pass with the proviso that he/she takes appropriate remedial course(s). A “fail” requires the student to repeat the written qualifying exam for that area.

The PhD candidate will select one research concentration from the following areas:

- **Decision and Control**
- **Design and Manufacturing**
- **Operations Research**

See each section below for the requirements for your concentration area:

### ***Decision and Control***

Candidates with a research concentration in Decision and Control will take three mandatory exams in the topics listed below:

1. Frequency-Doman Methods (SE 320: Introductory Control Systems)
2. State-Space Methods (SE 424: State Space Design for Control)
3. Nonlinear Systems (SE 520/ECE 528/ME 546: Analysis of Nonlinear Systems)

### ***Design and Manufacturing***

Candidates with a research concentration in Design and Manufacturing will take one of the three written examinations in the topics covered in the courses listed below:

1. SE 413: Engrg Design Optimization
2. IE 513: Optimal System Design

The remaining two written exams will be on the topics covered in any two courses listed below:

1. SE 530: Multiattribute Decision Making
2. SE 411: Reliability Engineering
3. SE 410: Component Design
4. SE 412: Nondestructive Evaluation

### ***Operations Research***

Candidates with a research concentration in Operations Research will take two of the three written examinations in the topics covered in the courses listed below:

1. IE 411: Optimization of Large Systems
2. IE 410: Stochastic Processes & Applic

The third exam will be on the material covered in one of these courses:

1. IE 510: Applied Nonlinear Programming
2. IE 511: Integer Programming
3. IE 512: Network Analysis of Systems
4. IE 521: Convex Optimization

## **ISE Oral Qualifying Examination**

The second component of the qual is an oral examination. The 45-minute oral examination will be based primarily on a presentation made by the student to a three-person oral examination committee (OEC)

within the candidate's research concentration. This examination will be conducted during the last three weeks of each semester.

The OEC will assign the student one journal paper to critically appraise during the oral exam in terms of:

- overall significance
- influence on the development of the field
- possible future research directions in the area of the paper, and
- connections to the student's research interests.

To avoid conflict of interest, no papers authored or co-authored by departmental faculty or affiliate faculty will be assigned for the oral examination. The presentation should be 25 minutes in length, leaving 20 minutes for questions. Questioning may range beyond the material in the assigned paper, and may include questions relating to the student's written examination problems.

**Students should not expect to defend their research in the Oral Examination.**

### **Breadth Requirement**

The PhD candidate will also be required to take three courses that are outside his/her research concentration, as a part of the breadth-requirement. The student must communicate these courses to the Graduate Programs Office via the my.ise petition portal (choose "other"). The Graduate Programs Office will notify the student of the decision to accept or deny the courses chosen.

The Graduate Programs Office will verify the Breadth requirement before the candidate's PhD Preliminary Examination.