

**Fall 2022**  
**IE Graduate Student Handbook**  
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# 1. APPLYING TO OUR GRADUATE PROGRAM

## Deadlines

Information on applying to any of our graduate programs can be accessed from our department's website [www.ime.psu.edu](http://www.ime.psu.edu). The graduate admission process is managed by LionPath. Application deadlines for admission are as follows:

| Degree                         | Admission Deadlines  |
|--------------------------------|--|
| M.S., Ph.D., Fall Semester     | December 1 of previous year                                    |
| M.S., Ph.D., Spring Semester   | September 1 of previous year                                   |
| MEng (online), Fall Semester   | July 10 (approximately 1 month prior to start of semester)     |
| MEng (online), Spring Semester | December 10 (approximately 1 month prior to start of semester) |
| MEng (online), Summer Semester | April 10 (approximately 1 month prior to start of semester)    |

Your application must be fully complete before you can be considered for admission.

# 2. TRANSITIONING TO OUR GRADUATE PROGRAM AFTER ADMITTANCE

## After Being Admitted:

After the department admits you and you accept, you will:

- receive a letter in GRADS (Status Page) from the Office of Graduate Enrollment Services informing you of your admission and current status. International students will be informed of the Directorate of International Student and Scholar Advising (DISSA) process. *(Receipt of this letter: February timeframe for fall entrance or October timeframe for Spring entrance)*
- receive email from IME Graduate Team regarding orientation date(s) and course scheduling information. *(Receipt of this letter: June timeframe for fall entrance or November timeframe for spring entrance)*
- be able to schedule courses and access PSU email account AFTER you receive the formal admission letter from the Office of Graduate Enrollment Services. For international students this will be a second letter after DISSA has confirmed financial guaranteed and visa. *(Receipt of this letter: Domestic—February timeframe/International: Varies for fall entrance or Domestic—October timeframe/International: Varies for spring entrance)*

## Before you arrive:

- Be sure that you regularly review your status page in GRADS (<http://gradschool.psu.edu/existing-application/>) and provide any requested documentation as soon as possible.

## When you arrive:

- Take advantage of the many new student orientation activities. There is a great deal of information provided at each orientation. We highly recommend that you attend all

appropriate orientation events; IE Department Orientation for new students is mandatory.

- Fall Semester Orientations typically begin two weeks before the start of classes.
- Spring Semester Orientations typically begin one week before the start of classes.

### **Selecting a Research Advisor**

Your M.S. or Ph.D. research advisor is typically selected during your first semester in your graduate program. The IE Graduate Program Coordinator (Dr. Rothrock) serves as your temporary research advisor. You may enroll in one or two research credits IE 600 with Dr. Rothrock during your first semester even if you do not have a permanent research advisor. All enrollment in IE 600 in subsequent semesters should be with your permanent research advisor.

### **Transferring Academic Credits**

In some cases, a student may be able to transfer graduate credits from a previous degree obtained at Penn State or other institutions to fulfill some M.S. or Ph.D. degree requirements. Transferring credits is done after a student arrives in consultation with the IE Department Graduate Program Coordinator.

### **Special Information for International Graduate Students**

The United States Department of Homeland Security (DHS) allows a duration of not more than three years for a master's degree and not more than six years for a doctorate, after the B.S. degree. Students entering a Ph.D. program with a master's degree are allowed not more than four years to complete the degree. Extensions can be made by the DHS, with approval from the student's academic adviser and the Penn State Directorate of International Student and Scholar Advising (DISSA) <https://global.psu.edu/article/advising>.

All international graduate students should become familiar with DISSA. This office is designed specifically for the special needs of international students, including their visas. Each semester, DISSA conducts a mandatory orientation program for new students. This orientation provides an opportunity for students to become familiar with campus, provides an opportunity to obtain a social security number, telephone service, etc., and provides information about shopping, apartments, school registration for children.

All international students on F-1 or J-1 visas must be registered as full-time students during both fall and spring semesters in order to maintain a proper visa status. The minimum load for full-time student is nine credits per semester. A student must get written approval from DISSA for registering less than nine credits in a semester, with the consent of the academic advisor. This could happen when the student is working on his/her thesis or dissertation, after completing all required course work.

### **Health Insurance (Residential Students Only)**

U.S. and International students must provide proof of health insurance coverage that meets a set of requirements, or students must purchase the health insurance through Penn State SHIP. Health insurance enrollment procedures, coverages, and costs change each year.

At the present time Graduate Assistants, Graduate Fellows, and Graduate Trainees are automatically enrolled in the Penn State Student Insurance Plan (SHIP) each fall semester for

medical, dental, and vision coverage. Students may choose to decline this coverage or add additional dependents by making changes to their selection in Workday by going to <https://worklion.psu.edu/>.

For detailed information regarding health insurance, please visit <http://www.studentaffairs.psu.edu/health-wellness/health-insurance>.

### **3. ACADEMIC POLICIES FOR ALL GRADUATE STUDENTS**

#### **Registration/GPA Requirements**

All graduate students must be continuously enrolled during fall and spring semesters, until graduation, even after completing all credit requirements for the degree. There are additional enrollment requirements for international students. (Refer to the Penn State Graduate Degree Programs Bulletin (<https://bulletins.psu.edu/graduate/>) and other sections in this document for more information.)

#### **SARI Requirements**

All residential and on-line graduate students at the university are required to undertake training in Scholarship and Research Integrity (SARI) and receive SARI certification. This SARI training has both on-line and in the classroom components. It should be completed by the end of the first year of study. See Appendix A for detailed SARI requirements.

#### **Details on Transferring Academic Credits**

In some cases, a student may be able to transfer credits from Penn State or other institutions. A maximum of 10 course credits from prior graduate coursework may be transferred toward a Penn State M.S. or MEng degree. A maximum of 24 course credits can be transferred from the student's master's degree toward IE Department Ph.D. degree requirements. The department Graduate Program Coordinator must approve all credit transfers. The course syllabus, a copy of its catalog description, and the transcript are required to transfer the credits of that course. The necessary course transfer forms are available from the IE Graduate Program Office. This transfer authority within the department; transfer credits will not appear on your Penn State transcript.

#### Transfer Credit Restrictions

- Credits earned to complete a previous master's degree cannot be used for a second master's degree at Penn State. However, if a master's degree was not completed at another institution, then some credits may transfer toward a master's degree at Penn State.
- Three credit courses from institutions with academic quarters are counted as two semester credits at Penn State.
- Credits earned in any course that substantially duplicate a Penn State Industrial Engineering (IE)-required undergraduate course cannot be transferred.
- Transfer credits must have been earned within the previous five years.
- Credits can be transferred only for courses with a grade of B or better. "Pass" grades cannot be transferred unless the institution can substantiate that a Pass grade is equivalent to at least a "B" grade.

- Up to 15 credits of Penn State Non-Degree Graduate Credits may transfer as IE Degree Graduate Credits
- Approved Penn State Undergraduate Credits to IE Degree Graduate Credits (6 credits maximum; needs undergraduate program adviser verification that credits were not required for B.S. degree)

### **Graduate Courses and Course Prerequisites**

A list of IE Department Graduate Courses (500 level courses) is available on the department's website. A more detailed course description for each of the classes is shown in Penn State LionPATH. In addition to these 500 level courses, students can enroll in certain 400 level courses to satisfy degree requirements. See Appendix B for a list of acceptable 400 level courses for IE graduate degree credit. Note that IE 596: Individual Studies credits cannot be applied towards degree coursework credits.

There are prerequisites to many graduate courses identified in LionPATH. These pre-requisites are for graduate student guidance only. You may enroll in a graduate class even though you have not completed the specific prerequisite courses listed. If you have any concerns about whether you have the appropriate background to succeed in these courses, please contact the course instructor. Students may also enroll in IE Department on-line classes to meet M.S. degree coursework requirements. However, international students can only enroll in 3 credits on-line courses during a semester.

### **Curricular Practical Training and Optional Practical Training for International Students**

International students who have been in F-1 status for at least one academic year are eligible for Curricular Practical Training (CPT), which is temporary employment in their field of study for purposes of gaining practical experience. There are several types of Optional Practical Training (OPT), including:

- Post-Completion OPT is the most common type of OPT; It begins after the completion of a student's degree program.
- Pre-Completion OPT is for work opportunities during the degree program for which CPT is not an option. This can include summer (as long as the student will return for fall semester) or during the academic year.

There are many restrictions on applying for OPT and CPT. Students should be in direct contact with a DISSA advisor early in the process to ensure eligibility and to receive on-time OPT or CPT approval. <https://global.psu.edu/category/employment>

## **4. INDUSTRIAL ENGINEERING DEGREE PROGRAMS**

### **MASTER OF SCIENCE (THESIS and NON-THESIS TRACKS)**

All M.S. students must be continuously registered for at least one credit during fall and spring semesters, until graduation, even after completing all credit requirements for the degree. This is a college and department requirement. There are no other departmental or university minimum registration requirements, except for international students. (Please refer to specific

information for international graduate students in this document and at <https://global.psu.edu/article/enrollment-requirements>.

### **M.S. Coursework Requirements**

A minimum of 32 credits, including two credits of IE Colloquium, are required to complete an M.S. degree in Industrial Engineering. A minimum GPA of 3.00 is required for graduation. M.S. students may select either the thesis or non-thesis degree track. All degree status changes, including degree-track changes, must be approved by the student's research advisor. The course requirements for an M.S. degree (Non-Thesis Track and Thesis Track) in Industrial Engineering are shown here.

#### **M.S.--Non-Thesis Track-27 Course Credits**

IE 505 Linear Programming (3 credits)

IE 511 Experimental Design in Engineering (3 credits)

21 additional course credits with the following restrictions:

- Minimum of 9 credits must be IE 500 level course credits
- Minimum of 12 credits must be 500 level course credits
- Minimum of 12 credits must be IE course credits

Research Credits (3 credits)

- IE 596

IE 590 Colloquium (2 credits)

**NOTE:** OR 590 may be substituted for 1 credit of IE 590

**Total Credits for M.S. –Non-Thesis Track: 32**

#### **M.S.--Thesis Track-24 Course Credits**

IE 505 Linear Programming (3 credits)

IE 511 Experimental Design in Engineering (3 credits)

18 additional course credits with the following restrictions:

- Minimum of 3 credits must be IE 500 level course credits
- Minimum of 6 credits must be 500 level course credits
- Minimum of 9 credits must be IE course credits

Research Credits (6 credits)

- IE 600

IE 590 Colloquium (2 credits)

**NOTE:** OR 590 may be substituted for 1 credit of IE 590

**Total Credits for M.S.—Thesis Track: 32**

### **Notes:**

- Students seeking a dual-title degree title in IE and Operations Research may substitute one credit of OR 590 for one of the two required credits of IE 590.
- Only 400 level courses from the IE departmental approved list can be taken for graduate credit. (See Appendix B )
- Certain courses taught by other departments duplicate course topics in IE courses. Students may not count the IE course and the corresponding duplicate course from another department toward their degree requirements. (See Appendix B)
- IE 596 (Individual Studies) credits cannot be applied toward course requirements.

- Students enrolled in the dual-title IE-OR degree must complete more specific coursework requirements as part of the minimum course credits for their dual-title M.S. <https://www.or.psu.edu/masters-degree/>

**SARI Requirements**

SARI requirements should be completed by the end of the first year of study. See Appendix A for detailed SARI requirements.

**M.S. Non-Thesis Track - Paper Requirements**

The M.S. paper must demonstrate the capability of the student to integrate and apply concepts and techniques learned in the courses to solve an engineering problem. The scope of the culminating project resulting in this paper must be specified by the student's research adviser who is selected by the student during the first semester of coursework.

The electronic copy of the approved culminating research paper must be submitted to the IE Department by the paper deadline which is typically near the midpoint of the final semester. This scholarly paper will be made publicly available through the IE Department. The format of the final paper can follow the [thesis formatting guidelines](#) specified by the Graduate School, or use IE Department M.S. Paper guidelines as described in Appendix C. At least one faculty reader other than the student's adviser must read and approve the paper, in addition to final approval by the IE Graduate Program Coordinator. The adviser must be a member of the graduate faculty from the IE Department; however, the reader can be a faculty member from within the department or graduate faculty member outside the department. Additional IE-OR Dual Title paper requirements are described at <https://www.or.psu.edu/masters-degree/>.

**M.S. Thesis Track – Thesis Requirements**

The content of the M.S. thesis should be of quality sufficient for publication in a refereed journal. The thesis should follow the format specified by the Graduate School. The adviser must be a member of the IE Department Graduate Faculty; however, the reader can be a Graduate Faculty Member from either within the IE Department or outside the Department. The approval of the Department Head or the Graduate Program Coordinator is also required. Additional IE-OR Dual Title thesis requirements are described at <https://www.or.psu.edu/masters-degree/>.

The review and approval of M.S. thesis is initiated by the student on the Graduate School Thesis Submission website <https://gradschool.psu.edu/completing-your-degree/thesis-and-dissertation-information/>. Final submission and departmental approval deadlines for M.S. thesis must be completed as per current deadlines well before the end of the semester.

|               | Fall 2022 | Spring 2023 |
|---------------|-----------|-------------|
| Submit Thesis | 11/4/2022 | 3/20/2023   |

Failure to meet these deadlines will delay the official awarding of your degree.

### **Obtaining an Operations Research Dual Degree During Your M.S.**

Students enrolled in Operations Research Dual Title degree program as part of their M.S. program should refer to the Operations Research Dual Title degree requirements for additional coursework and research paper/thesis approval requirements, <http://www.or.psu.edu/>.

### **Typical M.S. Time Sequence**

Most M.S. non-thesis track and M.S. thesis track students complete their degree requirements in 3 or 4 semesters. However, it is possible to complete M.S. degree requirements in one calendar year as follows:

#### **Non-Thesis**

1<sup>st</sup> Semester: 12 credits coursework, 1 credit IE 590, 1 credit IE 596 (Individual Studies)

2<sup>nd</sup> Semester: 12 credits coursework, 1 credit IE 590, 1 credit IE 596 (Individual Studies)

Summer: 3 credits coursework, 1 credit IE 596 (Individual Studies)

#### **Thesis**

1<sup>st</sup> Semester: 12 credits coursework, 1 credit IE 590, 1 credit IE 600 (Research)

2<sup>nd</sup> Semester: 12 credits coursework, 1 credit IE 590, 1 credit IE 600 (Research)

Summer: 4 credits IE 600 (Research)

### **MASTER OF ENGINEERING IN INDUSTRIAL ENGINEERING (ON-LINE)**

The Master of Engineering in Industrial Engineering is offered online through Penn State World Campus in partnership with the Penn State College of Engineering.

Students must complete 30 course credits at the 400-, 500-, or 800-level, of which 21 course credits must be earned at Penn State (i.e., only 9 credits can be transferred from other institutions). In addition:

- All students must successfully complete three credits of IE 894: Capstone Design.
- At least 18 credits must be in 500-level or higher courses (including IE 894).
- At least 15 credits must be in 500-level or higher IE courses (including IE 894).
- At least 21 credits of the 30 credits must be IE courses (including IE 894).

The Master of Engineering in Industrial Engineering has limited formal course requirements; the program tailored specifically to suit the student's needs and educational goals. The list of IE 400- and 500- level courses can be found here: [Courses - Industrial Engineering Master's Degree Online - Penn State World Campus \(psu.edu\)](#).

Students may select from a list of elective courses maintained by the program. This list may change over time in response to market demand. Students may also use the graduate certificate courses in Additive Manufacturing and Design, Supply Chain Management, and Engineering Leadership and Innovation Management.

For a full overview of the M ENG program, please visit: [Industrial Engineering Master's Degree \(M.Eng.\) Online - Penn State World Campus \(psu.edu\)](#).

## DOCTOR OF PHILOSPHY

### Course Requirements

A minimum of 49 credits consisting of 45 credits of course work and four credits of IE 590: Colloquium are required beyond the B.S. to complete a Ph.D. in Industrial Engineering, in addition to the research and dissertation work. The colloquium credit requirements are reduced from 4 credits to 3 credits for students entering with an M.S. Degree. In addition to course requirements of the Graduate School, all degree requirements as set forth in the [Graduate Degree Programs Bulletin](#), must be satisfied. The department course requirements are as follows:

### Requirements for a Ph.D. Degree in Industrial Engineering

| Course      | Credits  | Title           |
|-------------|--|-----------------|
|             |  |                 |
| Course work | 45 credits minimum   | Course work     |
| IE 590      | 4 credits minimum or 3 credits minimum for students with a prior M.S. degree | IE Colloquium   |
| IE 600/601  | No minimum requirement   | Thesis Research |

### Coursework Restrictions

|                                      |                    |
|--------------------------------------|--------------------|
| IE Course Credits:                   | 36 credits minimum |
| IE Course Credits at 500 level:      | 30 credits minimum |
| Non-IE Course Credits:               | 9 credits minimum  |
| Non-IE Course Credits at 500 levels: | 3 credits minimum  |

### NOTES:

- All students must choose a Qualifying Exam focus area. Each Qualifying Exam focus area includes 3 required IE courses that must be completed by a student in order to be eligible to take the Ph.D. Qualifying Exam.
- IE 596 (Individual Studies) credits cannot be applied toward course requirements.
- A maximum of 24 course credits can be departmentally transferred from the student's M.S. degree toward IE Ph.D. course requirements. The courses transferred will not appear on your Penn State transcript. Detailed procedures for course transfer are available from the IE Graduate Program Office.
- Not all IE 400 level elective courses can be taken for graduate credit. Please refer to the list in Appendix B. Students may not count duplicate courses from another department toward their IE coursework requirements. (See Appendix B)

- Up to two OR 590 OR Colloquium credits can be substituted for the required IE 590 (IE Colloquium) credits.
- Students enrolled in the dual-title IE-OR degree must complete more specific coursework requirements as part of the minimum 45 course credits for their Ph.D. <https://www.or.psu.edu/masters-degree/>.

### **SARI Requirements**

SARI requirements should be completed by the end of the first year of study. See Appendix A for detailed SARI requirements. Students who have previously completed SARI requirements as part of an earlier Penn State graduate degree, do not need to repeat SARI.

### **Typical Time Sequence**

The time required to complete a Ph.D. varies, depending on whether the student enters with a B.S. or M.S., and many other factors. The following shows a typical sequence for the purpose of illustration, it is assumed that a student has a half-time assistantship and takes 12 credits per semester.

- \* Year 1: Begin graduate study; select adviser; form Ph.D. Committee
- \* Before year 2: Complete Ph.D. Degree Qualifying Examination
- \* Year 3: Comprehensive Examination dissertation proposal
- \* Year 4: Final defense completed

This time sequence should be reduced by approximately one year for students beginning the Ph.D. program with a prior M.S. It is very important for students to identify an area of interest and adviser soon after beginning the program.

### **GPA Requirements**

A minimum GPA of 3.30 in the six IE 500 level courses for students to take the Ph.D. Qualifying Exam is required. A minimum overall GPA of 3.00 is required for final graduation.

### **Registration/Residency Requirements**

There are three registration requirements that a doctoral student must fulfill:

*Continuous Registration Requirement:* After a student passes the comprehensive examination, the student must register for at least 1 credit per semester (Spring and Fall) until graduation, even after completing all the credit requirements. After passing the comprehensive examination and after completing all course requirements, students can register for non-credit IE 601 (on-campus) or IE 611 (off-campus) every semester, until graduation;

*Residency Requirements:* Between admission to the Ph.D. program and completion of the Ph.D., a student must spend at least two consecutive semesters (summer sessions are not included) as a full-time student (registering for at least 9 credits), engaged in academic work at the University Park campus. These could be a spring-fall or a fall-spring semester sequence;

*Exam Credit Registration Requirement:* A student must be registered for at least 1 credit in the semesters in which the student schedules the Qualifying Examination, the comprehensive examination, and the final oral examination (including summer). Scheduling each of the comprehensive and the final oral examinations must be done at least three weeks before the date of the respective examination.

### **Transitioning from M.S. to Ph.D.**

If you are an M.S. student and wish to continue your studies as a Ph.D. student, you may apply for Ph.D. studies. In general, these “Change of Major/Degree” applications should be submitted by the same application close deadlines that apply to new student applicants.

<https://gradschool.psu.edu/graduate-admissions/how-to-apply/current-students/>.

### **M.S. Along the way for Ph.D. Students**

Most students who enroll directly into our Ph.D. program after completing their B.S. degree also get an M.S. degree along the way. This requires that students apply for a “Change of Major/Degree” on the Graduate School website <https://gradschool.psu.edu/graduate-admissions/how-to-apply/current-students/>.

## **Qualifying Examination**

### **Examination Formats and Focus Area Requirements**

The IE Department Ph.D. Qualifying Exam should be taken after completing three core courses in a specific deal focus area and three additional 500 level graduate classroom courses (9 credits) with an average GPA of 3.33 in all six classes. Students are encouraged to take the Qualifying Examination after their first two semesters of classes. All students must register for the Qualifying Exam with IE Department Graduate Program Staff two months prior to the posted date of exam.

#### **Human Factors Focus Area Core Courses**

- 1 IE 511 Experimental Design in Engineering
- 2 IE 553/BIOE553 Engineering of Human Work
- 3 IE 558 Engineering of Cognitive Work

#### **Manufacturing Focus Area Core Courses**

- 1 IE 550 Manufacturing Systems
- 2 IE 571 Product Design, Manufacturing Specifications, and Measurements
- 3 IE 527, 560, IE 586, or an approved IE 597 manufacturing processes course

#### **Operations Research Focus Area Core Courses**

- 1 IE 597 Advanced Linear Programming
- 2 IE 597 Advanced Stochastic Processes
- 3 IE 521 Nonlinear Programming

#### **Operations, Services and Analytics Focus Area Core Courses**

- 1 IE 516/SCIS 516: Applied Stochastic Processes
- 2 IE 570/SCIS 570: Supply Chain Engineering
- 3 E 582: Engineering Analytics

The specific format and components of the Qualifying Exam differ for each focus area within the department. For details on the Qualifying Exam format for each of the departmental focus areas, see Appendix D. All focus area qualifying exams include an oral examination and an English Competency Assessment that includes assessment of presentation skills, writing skills and English proficiency skills.

### **Examination Scheduling**

The Qualifying Exam is offered two times per year, one week before spring semester classes and one week before fall semester classes. Students are advised to take the exam after completing two semesters in the department. All students must register for the Qualifying Exam with IE Department Graduate Program Staff two months prior to the posted date of the exam.

### **Qualifying Examination Grading**

Students with acceptable overall Qualifying Exam performance are assigned a score of 'Pass'. Students with unacceptable overall Qualifying Exam performance are assigned a score of 'Fail'. Students who receive a score of Fail will be allowed to retake the entire exam, the failed components of the exam, or complete remedial coursework for their second attempt as directed by the Focus Area Qualifying Examination Committee. Students with unacceptable overall Qualifying Exam performance after a second attempt (Fail) will be directed to leave the Ph.D. program.

### **English Proficiency Requirements**

Students must pass the English Proficiency Examination that is part of the Qualifying Examination before they are permitted to schedule their Comprehensive Examination. This includes demonstrating proficiency in English speaking, writing, and presentation skills as well as the ability to effectively debate and answer questions verbally. Possible outcomes and remediation for either the Presentation Skills or the Writing Skills Proficiency Testing are:

- \* Unacceptable: Student will be required to take a writing/presentation course selected by the committee and achieve a minimum grade of 'B'.

- \* Acceptable: No remediation is required

## **Ph.D. Comprehensive Examination**

### **Doctoral Committee for Your Comprehensive Examination or Final Defense**

The doctoral committee of a student includes the student's adviser (or co-advisers) and must consist of at least four members from the Penn State Graduate Faculty. The adviser or at least one co-adviser must be a member of the graduate faculty of the department. At least one of those four members must be from outside the Department of Industrial Engineering. The majority of the committee members must be from the graduate faculty of the Department of Industrial Engineering. The chair of the committee is the student's adviser in most cases. The committee will direct the student's doctoral program—including the comprehensive exam, (proposal defense), and final defense—and must be formally approved by the Graduate School. The specific makeup of a student's doctoral committee is described at

<http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-602-phd-committee-formation/>. The student should see the department's graduate program staff assistant when he/she is ready to form the committee. Committees should be formed before the end of a student's first year of Ph.D. study.

*A student's Comprehensive Exam can be scheduled at any time after a student passes the Qualifying Exam.*

### **Comprehensive Examination Requirements**

It is strongly recommended that students schedule their Comprehensive Exam soon after the completion of their Qualifying Exam and their research topic has been identified.

In order to schedule the Comprehensive Exam, a student must: (1) be registered for the semester, including summer, for at least one credit, (2) have no missing or deferred grades, (3) have at least a 3.0 grade point average on their Penn State transcript.

The final defense of the student's dissertation defense cannot be scheduled until his/her adviser or all co-advisers have reviewed the Comprehensive Exam document prepared by the student. Both the content and style should be correct and appropriate and approved by the research advisor(s) before it is submitted to the members of the committee.

There should be at least three weeks between the delivery of the final draft of the Comprehensive Exam document to the committee members and the Comprehensive Exam. The Graduate School requires at least two weeks' notice for scheduling the final defense. Students should notify the graduate program staff assistant sufficiently in advance of the Comprehensive exam date so that the necessary paperwork can be prepared in a timely manner.

### **Final Defense**

It is strongly recommended that students defend their dissertations within 12 months after passing the comprehensive examination.

In order to schedule the Final Defense, a student must: (1) be registered for the semester, including summer, for at least one credit, (2) have no missing or deferred grades, (3) have at least a 3.0 grade point average, (4) have passed the Qualifying Examination within the past eight years. When a period of more than six years has elapsed between the passing of the comprehensive examination and the completion of the program, the student is required to pass a second comprehensive examination before the final defense oral examination will be scheduled.

The student is responsible for assuring the completion of the draft of the dissertation and for adequate consultation with members of the doctoral committee well in advance of the final defense.

The Graduate School requires at least two weeks' notice for scheduling the final defense. Students should notify the graduate program staff assistant sufficiently in advance of the dissertation defense date so that the necessary paperwork can be prepared in a timely manner.

There should be at least three weeks between the delivery of the final draft of the dissertation to the committee members and the final defense. All faculty within the Harold and Inge Marcus Department of Industrial and Manufacturing Engineering will be notified of the time, date, and location of the dissertation defense once it is scheduled. This defense is also open to the public.

**Important Note:** At least three members of the doctoral committee (including the thesis adviser or chair) must be physically present at the defense. If a member of the committee cannot be physically present, but will participate electronically in real time, this must be approved by the Graduate School at least three weeks before the scheduled date of the defense.

A doctoral student is required to complete the program, including acceptance of the doctoral dissertation or the passing of the final performance, within eight years after the date of successful completion of the Qualifying Examination. Extensions may be granted by the director of Graduate Enrollment Services in appropriate circumstances.

### **Dissertation Requirements**

Early in the final semester, prior to Ph.D. completion, a draft of portions of the dissertation must be submitted to the Graduate School for format review and approval.

<http://gradschool.psu.edu/current-students/etd/format-review/>

The Ph.D. dissertation must be of sufficiently high quality to be publishable in refereed journals. The Ph.D. final dissertation must be approved and signed by the Students Committee and the Department Head. The final approved electronic copy of the dissertation along with the completed signatory page must be submitted to the Graduate School by the specified deadline in order to graduate in a semester.

### **Operations Research Dual Degree or Operations Research Minor Option During Your Ph.D.**

Students enrolled in Operations Research Dual Title degree program or the Operations Research Minor as part of their Ph.D. program should refer to the Operations Research Dual Title degree requirements for additional coursework and research approval requirements,

<http://www.or.psu.edu/>.

## **5. Graduate Student Funding Opportunities**

### **Overview**

Graduate students are supported by Assistantships, Fellowships, and other stipend-only awards. Fellowship recipients are expected to carry a load of at least 12 course credits per semester (four 3-credit courses), as they are not required to work during the semester in which they are offered the fellowship. They may also take additional credits consisting of colloquium or research. Half-time graduate assistants are expected to work 20 hours/week and to carry 12 credits per semester, consisting of three 3-credit courses (until the student completes his/her course work), two credits of thesis research, and one credit of I E Colloquium.

Penn State College of Engineering and Departmental Fellowships As all of the following programs are highly competitive, students will need top grades and test scores to obtain funding from one of these sources. There are also targeted opportunities for top incoming students and incoming minority students. These are administered through the

Fellowships and Awards Office. The department nominates students for these fellowships. Both full and partial fellowships available for top students.

External Fellowships Most external fellowships require students to apply directly to the Fellowship sponsor. The IE Department will provide support to students applying for external fellowships.

### **Assistantships**

The department awards a limited number of assistantships. Both teaching and research assistantships are available. Students accepting teaching assistantships offered by the department are placed in a pool from which the department's instructional needs will be met. Every effort will be made to match students with their choice of assignments, but this cannot always be guaranteed. Research assistants are hired by faculty members based on the candidate's need and qualifications. It should be noted that offers for graduate assistantships are not made until admission has been granted by the Graduate School.

International applicants who are supported as a teaching assistantship must take the American English Oral Communicative Proficiency Test offered by Penn State, after their arrival on campus and obtain a minimum score of 250 in the test. Only students authorized by the department are permitted to take the AEOCPT at Penn State. Find more information at <https://aplng.la.psu.edu/programs/about-the-aeocpt/>.

A typical teaching assistant is responsible for carrying out laboratory teaching, grading, or other classroom support activities. A half-time teaching or research assistant is required to work 20 hours per week. Employment begins one week before the first day of classes and ends one week after classes are completed (or until after all final grades have been handed in by the instructor.)

Multi-year funding commitments to the student will state the intended funding time period along with the funding offered. Satisfactory progress must be made in the respective degree programs for continuation of funding.

### **Fellowships**

There are often eligibility requirements for fellowships. Some require U.S. Citizenship or Permanent Resident Status while others are open to international students. Students must apply for external fellowships directly through the funding agency, not through Penn State. There are also fellowships available from the Graduate School, the College of Engineering, and the Marcus Department. A student cannot directly apply for these fellowships, rather they must be nominated by the department.

## **6. TRANSITIONING FROM YOUR DEGREE PROGRAM (YOUR FINAL SEMESTER)**

### **Deadlines! Deadlines! Deadlines!**

A student who plans to graduate in a semester must officially file his/her intent to graduate on LionPATH, at the beginning of the semester. Students who fail to do this will not be able to graduate in that semester. The final version of master's thesis or dissertation should be

delivered to the research advisor sufficiently in advance of the deadline for the delivery to their committee, the Graduate School and the department. M.S. thesis and Ph.D. students must complete their final documents, obtain final signatures of the advisor, committee, and the Department Head or the Graduate Program Coordinator and submit the final electronic copy of the thesis to the Graduate School with the signed Approval Page by the specified deadline in order to graduate in a semester. Students seeking the M.S. degree with non-thesis track must submit their final papers signed by their advisor and reader to the department at least four weeks before the end of their terminal semester.

If a student cannot meet the Graduate School and department early deadlines for submitting the thesis or dissertation in a given semester, he/she can still complete other requirements for the degree and request for a letter from the Graduate School certifying that all other requirements for the degree have been satisfied, even though the official graduate date will be the following semester.

## **7. GENERAL INFORMATION FOR ALL GRADUATE STUDENTS**

### **Student Organizations**

- American Foundry Society (AFS) The AFS chapter is for students in industrial engineering, metal science and engineering, and other departments who are interested in metal casting.
- American Society for Quality (ASQ), ASQ has been a leader in identifying, communicating, and promoting the use of quality concepts, principles, and technologies.
- Engineering Graduate Student Council (EGSC) The purpose of the EGSC is to promote and enhance graduate studies within the College of Engineering through professional development activities, and to provide a forum for communication between graduate students, faculty, and administration within the College of Engineering.  
<https://www.egsc.psu.edu/upcoming-events/>
- Engineering Undergraduate Council (EUC) EUC allows for the bridge between the administration, faculty, and students of the College of Engineering at The Pennsylvania State University. <https://www.esm.psu.edu/academics/resources/student-organizations.aspx>
- Human Factors and Ergonomics Society (HFES) HFES is an interdisciplinary organization of professionals involved in the human factors field.
- Industrial Engineering Graduate Association (IEGA) IEGA was founded to serve the academic and social needs of graduate students in the Harold and Inge Marcus Department of Industrial and Manufacturing Engineering at Penn State. All current graduate students in the department are automatically members of IEGA.
- Institute of Industrial and Systems Engineers (IISE) IISE is the professional society devoted to serving the needs of industrial and systems engineering professionals.
- Institute for Operations Research and the Management Sciences (INFORMS) INFORMS serves the scientific and professional needs of operations research and management science (OR/MS) investigators, scientists, students, educators, and managers.

- National Organization for Business and Engineering (NOBE) NOBE is comprised of undergraduate engineering students interested in complementing their engineering knowledge with important aspects of business.
- Society of Manufacturing Engineers (SME) SME is an international professional society dedicated to serving its members and the manufacturing community through the advancement of professionalism, knowledge, and learning.

### **Faculty and Student Responsibilities**

The IE department faculty has developed a set of expectations and responsibilities for faculty and students pertaining to classroom teaching. A similar list was prepared by the Student Advisory Committee in consultation with the students. Both faculty and student representatives met to discuss these items and prepare a final list of responsibilities and expectations for both.

### **Responsibilities of the Faculty**

- \*To be prepared for every class.
- \*To develop a comprehensive syllabus covering topics to be studied, examination schedules, policies, office hours, etc. for distribution during the first week of class.
- \* To treat students and staff with respect and courtesy.
- \* To administer courses in a fair manner and in accordance with University policy.
- \* To assign meaningful homework.
- \* To provide meaningful feedback on graded material in a timely manner.
- \* To post and hold sufficient office hours, so as to be accessible to most students, and be available during those times.
- \* To do everything possible to enhance and enforce academic integrity.
- \* To develop fair assessment instruments which will be impartially and fairly utilized.
- \* To cover the prescribed topics in each course.
- \* To encourage student professional growth and participation in preparation for future careers.
- \* To provide an atmosphere conducive to learning.
- \* To instruct, as needed, on the use and safety of equipment.
- \* To provide informed advice on academic matters (such as course selection, scheduling, etc.)
- \* To inform students when classes or office hours cannot be met.
- \* Display enthusiasm in courses taught and be concerned about student learning.

### **Responsibilities of the Student**

- \* To attend every class unless extenuating circumstances occur (such as illness, emergencies, etc.)
- \* To treat faculty and staff with respect and courtesy
- \* To come to class prepared to actively listen and participate (having completed reading and other assignments)
- \* To exhibit academic integrity
- \* To respect other students and faculty in class through appropriate conduct (such as on-time attendance, attentions to class activities, etc.)
- \* To put forth an honest effort to understand material and prepare specific questions for faculty or teaching assistants when problems arise
- \* To provide prior information and documentation for situations meriting special attention (such as illness, athletic team travel, etc.)
- \* To meet with their advisor regularly to ensure that all academic requirements are met

- \* To follow the stated policies of each course
- \* To plan for their professional development and future
- \* To review prerequisite material as needed
- \* To properly and safely use and care for all department facilities and equipment
- \* To equally participate in all group labs, assignments, and projects
- \* To take SRTes seriously and provide a fair assessment of course and faculty
- \* Display enthusiasm for courses with a real concern for learning

### **Useful websites**

All in one mobile app for Penn State: <https://mobile.psu.edu/>

Alert System app: <https://psualert.psu.edu/psualert>

Graduate Student Ombudsperson Program: <https://gradschool.psu.edu/graduate-student-life/graduate-student-ombudsperson-program/>

## **8. CORONAVIRUS RESOURCES**

Coronavirus Information:

[https://virusinfo.psu.edu/?utm\\_campaign=banner?utm\\_campaign=banner](https://virusinfo.psu.edu/?utm_campaign=banner?utm_campaign=banner)

PennState Global Resources and Information related to the COVID-19 pandemic:

<https://sites.psu.edu/globalprogramsinfo/>

Keep Learning (great resource!) : <https://keeplearning.psu.edu/frequently-asked-questions/>

# **APPENDICES**

## APPENDIX A

### SCHOLARSHIP AND RESEARCH INTEGRITY CERTIFICATION REQUIREMENTS (SARI) (Residential and on-line students)

All scholars, from graduate students to senior investigators, confront ethical issues in their professional activities. Each year, thousands of Penn State investigators conduct research with integrity that would withstand the highest levels of scrutiny. Unfortunately, however, each year some Penn State personnel are involved in research misconduct allegations, inquiries, and investigations. Misconduct allegations have involved research personnel of every rank, and some findings have been serious enough to lead to recommendations of dismissal from the university.

Many cases involve situations where the responsible or ethical course of action was not clear to the investigator. Advance discussion of core principles and possible scenarios can help inform choices frequently made under pressure, helping to eliminate poor decisions.

The Scholarship and Research Integrity (SARI) program provides graduate students with opportunities to identify, examine, and discuss ethical issues relevant to their disciplines.

The SARI@PSU program is composed of two parts: an online training component (Part 1), and an interactive, discussion-based component (Part 2). The online training provides a common language and understanding of the history and principles of the responsible conduct of research. The discussion-based component provides an opportunity for in-depth exploration of important issues unique to each field of study.

**IE graduate students must complete all SARI requirements by the end of their first year of study.**

**Satisfying Part 1 Requirement:** Please go to <http://citi.psu.edu/> and use the following instructions:

- \* Select “University Park, Commonwealth, and other non-Hershey personnel”
- \* Select “Add a Course or Update Learner Groups”
- \* Select “I need to take RCR training to satisfy SARI@PSU training requirements”
- \* Select “Graduate”
- \* Select “Responsible conduct of research (RCR) course....”

| CITI Program RCE course models |   |
|--------------------------------|---|
| Required Modules               | Elective Modules (one required)                             |
| Authorship                     | Research, Ethics, and Society                               |
| Collaborative Research         | Environmental and Social Dimensions of Engineering Research |
| Data Management                | Using Animal Subjects in Research                           |
| Mentoring                      | Research involving Human Subjects                           |
| Peer Review                    | Export Controls and National Security                       |
| Research Misconduct            |   |
| Plagiarism                     |   |

**NOTE:** After successful completion of 80% or higher, you will receive a CITI transcript that you will submit to Cindy Mock (cxm901) once all SARI requirements have been fulfilled.

**Satisfying Part 2 Requirement:**

After logging into <http://canvas.psu.edu/>, you will be able to view the available SARI video segments. A score of 80 points is considered a passing score on the associated quiz. You will need to complete a total of 5 hours of video segments. Request your certificate at the completion of the module (keep for your SARI records). If you can't view videos after logging into Canvas, email Cindy at [cxm901@psu.edu](mailto:cxm901@psu.edu).

NOTE: As a substitute for 2 of the 5 Part 2 hours, you may attend an Office of Research Protections (ORP) SARI workshop. Maximum ORP credit towards Part 2 is 2 hours. Available ORP workshops are emailed to you at the start of each semester.

**Submitting Completed SARI:**

Email Cindy ([cxm901@psu.edu](mailto:cxm901@psu.edu)) with your Part 1 (CITI) transcript and Part 2 completion certificates. Cindy will confirm SARI completion and update your LionPath SARI Milestone. She will email you a confirming email once updates have been made.

## Appendix B

### Approved 400 Level Courses Students May Take for Graduate Credit

#### Non-IE Courses

ACC 4XX

ARCH 481/EDSGN 497 (Digital Design Media – Virtual Reality)

BME 419

CSE 410, 431W, 441W, CSE 456, CSE 458

ECON 402, ECON 483

EMCH 461

ENGR 497 (Special Topics: Design 4 Justice)

ENVSE 470

FDSC 430

FIN 4XX

MGMT 427

MKTG 437

STAT 460, STAT 463, STAT 464

EGEE 497 (Fuel Cells)

MATSE 425, MATSE 450

MATH 416, MATH 451, MATH 456, MATH 485, MATH 486

PHIL/STS 432 (Medical and Health Care Ethics) \*if student interest is in health systems

IST 462, IST 497 (IST Consulting and Project Management) IST 413

PSYCH 421, PSYCH 422, PSYCH 423, PSYCH 456, PSYCH 452, PSYCH 413

MIS 431, 479

ME 497 (Fuel Cell Engines)

SCM 400, 404, 405, 406, 421, 450

WP 416/497 (Wood Industries Management Development)

#### IE Courses

IE 402, IE 428, IE 454, IE 456, IE 466, IE 468, IE 478, IE 479

IE 497 (Micro/Nano Fabrication)

IE 497 (Data Envelopment Analysis)

#### Restrictions on IE 500 Level Courses

##### **500 Level Courses Not Accepted Toward IE Degree**

IE 596 or other 596 Independent Study Courses without prior approval

##### **500 Level Courses That Duplicate IE 500 Courses**

The following 500 level courses can only count as IE degree credit if students do not take the corresponding IE 500 level courses listed.

STAT 503/If IE 511 is not taken

SCM 545/If IE 522 is not taken

##### **IE Cross-Listed Courses**

The following 500 level courses are cross-listed with IE 500 courses. Students may enroll in either the IE or the cross-listed courses for IE course credit.

IE 561/EDSGN 561

IE 546/EDSGN 546

**Note:** On-line courses at Penn State as well as residential courses can be used to satisfy degree requirements. However, international residential students are only allowed to take 3 credits of on-line course work per semester and must be registered for 6 residential credits.

## Appendix C

### Alternate IE Department M.S. Non-Thesis Track Paper Guidelines

Upon consent of your M.S. paper advisor, IME M.S. papers may be prepared and submitted according to the following guidelines instead of submitting it in traditional thesis format.

- The content, length, and structure of the paper is expected to be acceptable for publication in a peer-reviewed professional journal or conference proceedings. Examples of papers that would not meet this standard would be a technical report to a sponsor, or a paper submitted to a conference not requiring a full-paper peer-review process.
- In the case of a multiple-author paper, the degree candidate must be the first author, and the paper must be primarily the work of the degree candidate. If there are coauthors other than the degree candidate and his/her faculty advisor, then a brief summary of the contributions of each coauthor and an estimate of each coauthor's percentage of effort must be included as an addendum to the departmental signature page. In general, the combined contribution of co-authors other than the advisor should be less than 33%.
- If the paper has already been published or has been accepted for publication, then the actual journal- or conference-formatted paper or manuscript should be submitted. Documentation must be provided to show that the paper has been published or has been accepted for publication. The role of the reader in this case is primarily to confirm that the target journal/proceedings meets the criteria outlined above, and that the documentation is in order.
- If the paper has been submitted for publication but has not yet been accepted, or has not yet been submitted, then the actual journal-formatted manuscript should be submitted. Documentation should be provided if the manuscript is under consideration for publication and if reviewer comments are available, reviewer comments should be provided. The reader in this case will effectively have the role of a peer reviewer, and will judge whether the manuscript is, in principle, suitable for journal or refereed conference publication.

## **APPENDIX D**

### **IE Ph.D. Qualifying Exam Formats**

All Ph.D. students must successfully complete their Qualifying Exam in one of the following focus areas: Human Factors, Manufacturing, Operations Research or Operations, Services & Analytics

#### **I. Human Factors Focus Area** (Faculty Coordinator: A. Freivalds)

The Human Factors Focus Area Qualifying Exam should be taken after completing the three core courses listed and three additional 5XX level graduate classroom courses (9 credits) with an average GPA of 3.33 in all six classes.

##### **Required Core Courses – Human Factors Focus Area**

- 1 IE 511 Experimental Design in Engineering
- 2 IE 553/BIOE553 Engineering of Human Work
- 3 IE 558 Engineering of Cognitive Work

Student must also complete three additional 500 level graduate classroom courses (9 credits). Students are strongly encouraged to take Human Factors domain courses.

##### **Human Factors Domain Course Group**

- IE 533 Workforce Engineering
- IE 552 Musculoskeletal System Mechanics
- IE 557 Human-in-the-Loop Simulation
- IE/EDSGN 549 Design Decision Making
- IE 548 Interaction Design
- IE 505 Linear Programming
- IE 516 Applied Stochastic Processes
- IE 520 Multiple Criteria Optimization
- IE 547 Designing for Human Variability
- IE 550 Manufacturing Systems
- IE 556 Robotic Concepts
- IE 568 Healthcare Systems Engineering
- EME 510 Health and Safety Engineering
- IST 521 Human Computer Interaction
- IST 522 Models of Human Computer Interaction
- IST 525 Computer-Supported Cooperative Work
- IST 526 Development Tools and Visualizations for Human-Computer Interaction
- IST 531 Human Information Behavior
- KINES 565 Neuro Basis Movement
- KINES 574 Biomechanical Modeling

KINES 578 Skeletal Physiology  
KINES 579 Adv. Human Motion  
PSY 521 Cognitive Studies

The Qualifying Exam will cover topics from the required core courses. The Qualifying Exam has two components: a take-home written exam and an oral exam. A student is expected to pass both of these components in order to successfully pass the Qualifying Exam. The process will be as follows:

- **Take-home exam:** Each student will answer three questions in the Human Factors and Ergonomics core course areas.
- **Oral exam:** Students that pass the written exam will be permitted to take the oral portion of the exam. Each student will be asked to make a 15-minute presentation of his/her potential Ph.D. topic. A committee in the Human Factors and Ergonomics area will meet and vote on the student presentation.

Both written and oral English proficiency will also be formally assessed during the Qualifying Examination by the Qualifying Examination Committee.

## II. **Manufacturing Focus Area** (Faculty Coordinator: S. Joshi)

The Manufacturing Focus Area Qualifying Exam option should be taken after completing the three core courses listed and three additional 5XX level graduate classroom courses (9 credits) with an average GPA of 3.33 in all six classes.

Required Core Courses – Manufacturing Area

- 1 IE 550 Manufacturing Systems
- 2 IE 571 Product Design, Manufacturing Specifications, and Measurements
- 3 IE 527, 560, IE 586, or an approved IE 597 manufacturing processes course

Student must also complete three additional 500 level graduate classroom courses (9 credits). Students are strongly encouraged to take manufacturing domain courses for their three additional courses.

### **Manufacturing Domain Course Group**

- I E 527 Additive Manufacturing
- IE 546/ME 546: Designing Product Families
- IE 550 Manufacturing Systems
- I E 560: Manufacturing with Materials
- I E 563: Computer-Aided Design for Manufacturing
- IE 571: Product Design, Manufacturing Specifications, and Measurements
- I E 572: Discrete Part Metrology
- IE 586 Machining Process Design and Theory
- I E 556: Robotic Concepts
- I E 567: Distributed Systems and Control
- IE 597 Weld Design and Performance

The Qualifying Exam will cover topics from the required core courses. The Qualifying Exam has three components: an in-class written exam, a take-home examination, and an oral exam. A student is expected to pass all these components in order to successfully pass the Qualifying Exam. The process will be as follows:

- **In-class written exam:** This component consists of one examination per core requirement course. Each student will have two hours to complete each exam. The examination will be closed book/closed notes and is typically given the week prior to the start of the spring and fall semester.
- **Take-home exam:** Each student will select one question from the questions submitted by the manufacturing faculty. Questions by the student's advisor will be excluded from the pool. The question will be open ended, with content related to one of the manufacturing domain courses listed above. The intent of the exam is to evaluate the student's ability to conduct independent research. The expectations are that the student will 1) review the research literature, 2) draw upon relevant subject knowledge to evaluate previous work, 3) articulate a clear problem statement that defines critical gaps in the current state of the art/science, 4) articulates the goals, objectives, and

research plan necessary to solve the problem within a 12-month period. Each student will have three days to complete this examination, which will typically be given after the in-class exam, but prior to the start of the semester.

- **Oral exam:** Each student will make a 15-minute oral presentation of their take home exam solution. This exam will be held by the manufacturing faculty during the first or second week of the semester.

Both written and oral English proficiency will also be formally assessed during the Qualifying Examination by the Qualifying Examination Committee.

### III. Operations Research Focus Area (Faculty Coordinator: T. Friesz)

The Operations Research Focus Area Qualifying Exam should be taken after completing the three core courses listed and three additional 5XX level graduate classroom courses (9 credits) with an average GPA of 3.33 in all six classes.

#### Required Core Courses – Operations Research Area

- 1 IE 597 Advanced Linear Programming
- 2 IE 597 Advanced Stochastic Processes
- 3 IE 521 Nonlinear Programming

The additional 500 level required classroom courses can be taken in any subject area, however students are strongly encouraged take their additional courses in the operations research area from Domains A and B (listed below) with at least one course from each domain. In addition, students are highly encouraged to take Stat 514 (Theory of Statistics II).

#### Domain A: Mathematical Programming

- IE 510 Integer Programming
- IE 512 Graphs and Networks
- IE 519 Dynamic Programming
- IE 520 Multiple Criteria Optimization
- IE/EE 585 Convex Optimization
- IE 588 Nonlinear Networks and the Price of Anarchy
- IE 589 Dynamic Optimization and Differential Games
- IE 597X Robust Optimization
- IE 597X Stochastic Optimization

#### Domain B: Stochastic Processes/Statistical Methods

- IE 509 Operations Research: Waiting Line Models
- IE 511 Experimental Design in Engineering
- IE 522 Discrete Event Systems Simulation
- IE 530 Introduction to Financial Engineering
- IE 555 Statistical Process Monitoring and Analysis
- IE 583 Response Surface Methodology and Optimization
- IE 584 Time Series Control and Process Adjustment
- IE 597X Stochastic Optimization
- EE 560 Probability, Random Variables and Stochastic Processes
- STAT 513 Theory of Statistics I
- STAT/MATH 517 Probability Theory I
- STAT/MATH 518 Probability Theory II
- STAT/MATH 519 Topics in Stochastic Processes
- STAT 551 Linear Models
- STAT/MATH 557 Data Mining I
- STAT 561 Statistical Inference I

The Qualifying Exam will cover topics from the three required core courses. The exam has two components: an in-class written exam and an oral exam. A student is expected to pass both these components in order to successfully pass the Qualifying Exam. The process will be as follows:

- (A) **In class written exam:** This exam will comprise of three 1-hour exams associated with each core course. The exam will be closed book/notes unless a different format is announced in advance. An important aspect of the exam is to assess the way the student thinks about a given problem and then approaches the solution. Each exam will be graded anonymously by the faculty member who prepared the questions. A student is deemed to have passed the written exam if he/she passes each of the three exams. If a student is deemed to have failed any of the three exams, he/she will have to retake the exam(s) in the next round. The student will be deemed to have passed the written exam, if he/she passes all three exams.
- (B) **Oral Exam:** Students that pass the written exam, will be allowed to take the oral portion of the exam. This component will be conducted by the OR faculty and the student's advisor. The student will give a 20-minute presentation on a research topic selected by the student and the advisor. The OR faculty, except the advisor, may ask questions during or after the presentation related to the research topic or course material from the 3 core courses taken by the student. Each OR faculty, except the advisor, will grade the performance.

### III. **Operations, Services and Analytics** (Faculty Coordinator: P. Griffin)

The Operations, Services and Analytics Qualifying Exam – Manufacturing Focus should be taken after completing the following three core courses: and three additional 5XX level graduate classroom courses (9 credits) with an average GPA of 3.33 in all six classes.

Required Core Courses – OSA Area

- 1 IE 516/SCIS 516: Applied Stochastic Processes
- 2 IE 570/SCIS 570: Supply Chain Engineering
- 3 IE 582: Engineering Analytics

Student must also complete three additional 500 level graduate classroom courses (9 credits). Students are strongly encouraged to take OSA domain courses for their three additional courses.

#### **OSA Domain Group**

- IE 478: Retail Services Engineering
- IE 505: Linear Programming
- IE 507: Operations Research: Scheduling Models
- IE 510: Integer Programming
- IE 511: Experimental Design in Engineering
- IE 517: Models and Technologies for Financial Services
- IE 519: Dynamic Programming
- IE 521: Nonlinear Programming
- IE 522: Discrete Event Systems Simulation
- IE 530: Financial Engineering
- IE 550: Manufacturing Systems
- IE 562: Expert Systems Design in Industrial Engineering
- IE 567: Distributed Systems and Control
- IE 568: Healthcare Systems Engineering
- IE 597: System Informatics and Control
- IE 597: Service Networks: Empirical Analysis, Modeling & Management
- IE 597: Workforce Engineering

The Qualifying Exam will cover topics from the required core courses. The Qualifying Exam has two components:

- (a) **In-class written exam:** The affiliated faculty will choose an exam committee of three faculty to administer the written portion of the exam. The written portion will focus on the methodology knowledge and its application from core course areas. Each faculty member will write one question. Students will take the questions as an in-class exam format, and each faculty member will grade his/her question.
- (b) **Oral exam:** -Students that pass or pass with condition the written exam, will be allowed to take the oral portion of the exam. The oral question will be provided by the student's

research advisor. If the student does not yet have a research advisor, the question will be provided by the affiliated faculty. Students will be asked to make a 15-20 minute research presentation to the affiliated faculty. Questions may be asked by the affiliated committee around this presentation.

Both written and oral English proficiency will also be formally assessed during the Qualifying Examination by the Qualifying Examination Committee.

## Appendix E

### Program Requirements for the Dual Degree (M.S., and Ph.D.) And Minor in Operations Research (Ph.D.)

To qualify for a dual-title degree, students must satisfy the requirements of the IE graduate program in which you are enrolled and the appropriate OR Dual Degree requirements. Students must enroll in OR 590 Colloquium for at least 1 credit in each year enrolled in the program and in residence. The maximum number of OR 590 credits for a Master student is 2, and for a Ph.D. student is 4.

#### Master Dual-title degree

##### Course Requirements

For the Master dual-title degree in OR, the minimum requirements are:

- 6 credits in stochastic/statistical methods, including a minimum of 3 credits in stochastic processes and 3 credits in statistical methods.
- 6 credits in optimization, including 3 credits in linear programming.
- 3 credits in computational methods.
- 3 credits in applications/specialization.

The minimum number of credits for Master students is **18 credits** of OR approved classes, if a thesis is required for the completion of the program. All Master students that choose a non-thesis track are required to take a minimum of **24 credits**. It is the prerogative of the graduate major program to assign the 6 additional credits to one or more of the following categories: stochastic/statistical methods, optimization, computational methods, or applications.

A minimum of 9 credits must be in the 500 series. Particular courses may satisfy both the graduate major program requirements and those in the OR program. A list of courses that will satisfy the OR course requirements can be found in the graduate program office and in the OR Website (<http://www.or.psu.edu/or-program-course-catalog/>).

##### Thesis Requirements

If a thesis is required for the completion of the student's master program, the supervisor must be a member of the Graduate Faculty recommended by the chair of the program granting the degree and approved by the OR committee as qualified to supervise thesis work in operations research. The reader of the thesis must be an OR faculty member external to the student's major program.

#### Ph.D. Dual-title degree

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 doctoral committee and reflects their original research

and education in both their primary graduate program and OR. 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 doctoral committee, the head of the graduate program, and the Graduate School.

### **Course Requirements**

The minimum requirements for the Ph.D. dual-title degree in Operations Research are:

- 9 credits in stochastic/statistical methods, including a minimum of 3 credits in each of the areas of statistical methods and stochastic processes
- 9 credits in optimization, including a minimum of 3 credits in linear programming
- 6 credits in computational methods, including a minimum of 3 credits in simulation
- 6 credits in computational methods, including a minimum of 3 credits in simulation
- 12 credits in applications/specialization

The minimum number of credits for Ph.D. students is **36 credits** of OR approved classes, with a minimum of 18 credits in the 500 series. Particular courses may satisfy both the graduate major program requirements and those in the OR program. A list of courses that will satisfy these requirements can be found in the graduate program office and in the OR Website (<http://www.or.psu.edu/or-program-course-catalog/>).

### **Candidacy Examination**

The candidacy examination committee for the dual-title Ph.D. degree 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 candidacy examination, containing elements of both the primary graduate degree program and Operations Research. Dual-title graduate degree students may require an additional semester to fulfill requirements for both areas of study and, therefore, the candidacy examination may be delayed one semester beyond the normal period allowable (<https://www.or.psu.edu/ph-d-degree-2/>)

### **Doctoral Committee**

In addition to the general Graduate Council requirements for doctoral committees, the chair and at least two members of the doctoral committee of an OR dual-title Ph.D. student must be members of the OR Graduate Faculty. One of these two members should be the external member in the student's doctoral committee. Faculty members who hold appointments in both programs' Graduate Faculty may serve in a combined role. The OR representatives on the student's doctoral committee will develop questions for and participate in the evaluation of the comprehensive examination.

### **[Ph.D. Minor in OR](#)**

A Ph.D. minor program in Operations Research is available for doctoral students who find it advantageous to include advanced quantitative methods of systems analysis in their programs of

study and have been approved to do so by their doctoral committees. To qualify for a minor in Operations Research, students must satisfy the requirements of their graduate major programs, meet the same admissions prerequisites as the Master dual-title degree students, and meet the course requirements listed below.

Official requests to add the minor to a doctoral candidate's academic record must be submitted to Graduate Enrollment Services prior to establishment of the doctoral committee and prior to scheduling the comprehensive examination.

### **Coursework Requirements**

The minimum requirements for the Ph.D. degree with a minor in Operations Research are:

- 6 credits in Stochastic/Statistical Methods including a minimum of 3 credits in each of the areas of statistical methods and stochastic processes.
- 6 credits in Optimization.
- 3 credits in Computational Methods.

The minimum number of credits for Ph.D. students with a minor in OR is **15 credits** of OR approved classes, with a minimum of 6 in the 500 series.

### **Doctoral Committee**

The doctoral committee for a student seeking a minor in Operations Research must have at least one member who is part of the OR faculty (<http://www.or.psu.edu/faculty/>).

For additional information please contact: Dr. José Ventura, Chair of Operations Research, Leonhard Building, 814-863-2358

## Appendix F

### PH.D. DEGREE CHECKLIST

- Accept admission to Ph.D. program
  - \* Graduate Program Coordinator will provide initial advising until you are able to determine your area of research and find an adviser.
- Schedule courses
  - \* The College of Engineering requires that all **funded** Ph.D. Students register for 12 credits.
- Transfer credits
  - \* A maximum of 24 course credits out of the minimum required 45 course credits can be transferred from the student's M.S. degree.
- Determine the number of credits required to complete your degree
  - \* Plan your classes strategically. Depending on the focus area that you are planning to select, you may be required to take certain courses before taking the exam. (OR, OSA, MFG, HF)
  - \* Some courses are not offered every semester. Some may typically only be offered in fall semesters while others may only be offered in spring semesters.
- Officially select an advisor
  - \* By the end of your first semester, you must determine your research advisor. The selection of an adviser is through mutual agreement between you and the faculty member.
- Complete SARI requirements
- Qualifying Exam
  - \* Students planning to take the Qualifying Examination in Spring semester must make their intentions known, to the Graduate Program Staff Assistant, by the second week in November and those planning to take it in Fall semester, by the middle of July. The Graduate School requires that qualifying exam be done within 3 semesters of admission. This exam also includes English Proficiency evaluation.
- Appoint Ph.D. Committee
  - \* See Graduate Staff Assistant to obtain Doctoral Committee Appointment Form and Instructions.
- Familiarize yourself with the Thesis/Dissertation Guide
  - \* <https://gradschool.psu.edu/completing-your-degree/thesis-and-dissertation-information/>
- Submit dissertation proposal to committee
  - \* The student should submit his /her dissertation proposal to the committee, well in advance of the comprehensive examination, to allow committee input.
- Schedule Comprehensive Exam
  - \* The Comprehensive Exam must be formally scheduled with the Graduate School at least two weeks prior to the date of the examination. See Graduate Staff Assistant to book conference room and to complete the necessary exam paperwork. It is recommended that students complete the Comprehensive Exam within 6 semesters.
- Pass Comprehensive Exam
  - \* The Graduate Staff Assistant will report the results to the Graduate School.

- Register for IE 601
  - \* After passing the comprehensive exam, you can register for IE 601 which will give you full-time status at a cheaper tuition rate.
  - \* Must contact Graduate Staff Assistant to register for IE 601.
- Check Thesis Office Calendar for deadlines
  - \* <http://www.gradschool.psu.edu/current-students/etd/thesisdissertationperformance-calendar/>
    - Activate Intent to Graduate
    - Submit Dissertation for format review.
- Deliver draft of dissertation to Advisor for review
  - \* The Graduate School requires that you allow at least three months between the comprehensive exam and the final oral exam.
- Deliver draft of dissertation to all committee members for review
  - \* This should be done at least 3 weeks prior to scheduling the final defense.
  - \* This is also the time to discuss possible dates for your oral exam and find a date agreeable to all committee members.
- Schedule Final Oral Defense
  - \* The Final Oral Exam must be formally scheduled with the Graduate School at least two weeks prior to the date of the examination. See the Graduate Staff Assistant to book a conference room and to complete the necessary exam paperwork.
- Pass Final Oral
  - \* The Graduate Staff Assistant will report the results to the Graduate School.
  - \* **Note: Students visas for international students expire 28 days after passing the oral defense.**
- Collect signatures on doctoral signatory page
  - \* Make all final corrections and submit a copy of the final document, along with doctoral signatory page, to each committee member. Please allow sufficient time for review of corrections and to collect signatures.
- Submit final dissertation to the etd site
  - \* Refer to Thesis/Dissertation Calendar and etd submission information. <https://gradschool.psu.edu/completing-your-degree/thesis-and-dissertation-information/how-to-submit-a-doctoral-dissertation/>
- Refer to Commencement link for graduation instructions.
  - <http://commencement.psu.edu/>
- CONGRATULATIONS!**