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GRADUATE MANUAL

(August 2009)

Disclaimer

The information contained herein is provided for your reference. Please be advised that University, School, and Department policies and requirements are subject to periodic changes. The Department of Industrial Engineering reserves the right to correct and/or amend the information without advance notice. For additional information about graduate study at the University of Pittsburgh, Department of Industrial Engineering please contact the graduate program director at (412) 624-9830 or send e-mail to gradie@engr.pitt.edu.

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1.0 Introduction

The Department of Industrial Engineering offers a professional, 30-31 credit Master's degree program, as well as a 72-credit Doctoral degree program (or 42 credits beyond a Master's degree in Industrial Engineering) for those interested in research or academic careers. The department also offers a dual degree MS/MBA program in cooperation with the Katz Graduate School of Business and an innovative flexible doctoral program with reduced residency requirements that is aimed at outstanding individuals who already have a Master's degree.

This document describes all issues relevant to the graduate program. Please note that the department frequently updates its policies regarding the graduate program and while every attempt is made to keep this document current, students are strongly advised to check with the graduate program director if there are questions or concerns.

2.0 Admission Requirements and Procedures

For admission to full graduate status, students must have an undergraduate degree with at least a B average (i.e., a GPA greater than 3.00/4.00) in engineering, mathematics, statistics or one of the natural sciences. Outstanding students with degrees in other disciplines such as business, economics, or computer/information sciences may also be considered on a case-by-case basis, provided they have significant work experience and/or very high academic standing. Regardless of the undergraduate degree, all applicants must have had calculus, linear algebra and matrices, and a calculus-based undergraduate course in engineering probability and statistics. In addition, they are expected to be conversant with at least one programming language (such as C, FORTRAN, Java, C++, etc.) and common computer tools such as word-processors and spreadsheets. Admission standards for the Ph.D. program are significantly higher than those for the M.S. program.

2.1 GRE

All applicants are required to take the Graduate Record Examination (GRE) - General Test. This requirement is typically waived only for working professionals who are applying to be part-time Master's students, or for students graduating with a B.S. in engineering from a reputable U.S. university. There is no minimum score requirement - the GRE scores are considered along with other factors such as grades, recommendation letters and the quality of the applicant's undergraduate program when making decisions regarding admission and financial assistance.

2.2 TOEFL

The Test of English as a Foreign Language (TOEFL) must be taken if the applicant's native language is not English. The School of Engineering requires a score of 550 (213 using the computer scale; 80 on the Internet scale) or higher on the TOEFL for admission to graduate study. **This requirement cannot be waived**. The only exception is if the applicant has already received a degree from an accredited institution in the United States. Furthermore, all students receiving less than 650 on the TOEFL are required to take the Michigan English placement test upon arrival at Pitt.

2.3 Other Requirements

Applicants must formally apply using the appropriate forms. The application package includes the application form, a complete set of original transcripts from all prior programs of study, at least two letters of recommendation, a personal statement, documentation of available finances (for international applicants), and an application fee.

2.4 Application Procedure

There are several different ways to obtain a complete application package:

1. Download forms from *http://www.engr.pitt.edu/admissions/graduate/download.html*. International applicants should download the international application package from *http://www.engr.pitt.edu/admissions/graduate/internationalApp.html*.

2. Send e-mail to: *gradie@engrng.pitt.edu*. Be sure to include your name and complete mailing address. Alternatively, contact the program via telephone or surface mail:

Graduate Program
1048 Benedum Hall
Department of Industrial Engineering
University of Pittsburgh
Pittsburgh, PA 15261
Phone: (412) 624-9830; Fax: (412) 624-9831

3. You may also apply on-line by going to *https://app.applyyourself.com/?id=up-e*.

The School of Engineering deadlines for application are as follows:

- Fall Term: March 1
- Spring Term: July 1
- Summer Term: February 1

However, applications are accepted and reviewed on an ongoing basis. International applicants are encouraged to apply at least eight to ten months before their intended starting date. Applicants to the Ph.D. program should refer to Section 5.1 for deadlines for assistantship applications. All final financial aid decisions are made by the department chair based on recommendations from a graduate admissions committee consisting of the graduate program director and three to four other faculty members.

3.0 English Proficiency and Teaching Assistant Certification

In order to understand lectures and to participate successfully in class discussions, graduate students must possess sufficient knowledge of English. All students must demonstrate proficiency in English, either by obtaining acceptable scores on the TOEFL or by virtue of a degree from an institution in the United States. All students with a TOEFL score less than 650 ordinarily take the Michigan Test of English Language Proficiency upon arrival. If remedial courses in English as a foreign language are recommended as an outcome of the Michigan Test, the department typically requires that these recommendations be followed.

In keeping with the University Policy on Certification of English Language Fluency for Teaching, students who are not native speakers of English and are appointed as teaching assistants or teaching fellows are required to take a separate English test upon arrival. Such individuals who do not perform satisfactorily on the test are given non-teaching assignments and are required to take special course work in English until they attain passing scores. An unsatisfactory score at the time of reappointment is sufficient cause for non-renewal.

The Department of Industrial Engineering requires that all international students who intend to pursue a doctoral degree take this test.

4.0 Tuition and Fees

Current information on tuition and fees may be found by visiting the appropriate University of Pittsburgh web sit at *http://www.ir.pitt.edu/tuition/index.html*.

5.0 Financial Assistance

Admission to the graduate program does not imply the granting of financial aid. However, most full-time doctoral students are supported through fellowships and teaching/research assistantships; these awards are based primarily on academic merit. **It is impossible for faculty members or administrators to meaningfully predict the chances of a specific applicant receiving an assistantship** - this depends on a number of factors such as the anticipated availability of funds, the quality of the other applicants, specific departmental requirements, etc. The department welcomes applications for aid from individuals with outstanding credentials; however, it should be kept in mind that these awards are highly competitive. In general, awards are made only to students pursuing a Ph.D. International applicants with a terminal Master's degree objective are not awarded graduate assistantships; however, outstanding M.S. applicants with degrees from ABET accredited institutions in the U.S. who have the potential to contribute to teaching and/or research may be considered for these awards. A terminal Master's student who is awarded an assistantship is required to write a Master's thesis. This requirement is waived only if the student goes on to write a Ph.D. dissertation. All awards are made for the academic year, but the stipend (which is set by the university) is adequate to take care of living expenses for the calendar year; the Office of International Education considers the stipend for a full assistantship (20 hours per week) as being adequate for issuing documentation in support of student visa applications. Every effort is made to provide extra support over the summer term, but such support is in general not guaranteed. While renewals are not automatic, barring unforeseen circumstances assistantships are generally renewed as long the student (a) performs well both academically and in assistantship duties, and (b) makes satisfactory progress towards his or her degree objective. Assistantships are typically awarded only at the beginning of the Fall term, although awards starting in the Spring term are sometimes available.

Final assistantship decisions are made by the department chair based upon the recommendations of the graduate committee. Individual faculty members cannot make offers or commitments directly to students, and applicants are requested to not contact individual faculty members to see if they will support them. Applicants interested in working with a specific faculty member should state this in their applications, and every consideration will be given to their preferences. In the event that an assistantship is declined it is offered to the next person on the waiting list. Applicants have the option to explicitly state in their applications that they do not wish to be considered for admission without financial aid. In such cases, the department will still consider the applicants and if they are academically acceptable, offer them the option of trying to arrange for alternative financing for their studies; typically this must be done by May 1.

5.1 Deadlines

Applications for financial aid should be received no later than January 15th for the following Fall term. The form for this is included in the application package. Typically, award decisions are made in March and awardees have until about April 15 to accept or decline offers. Since the number of applications tends to be large, applicants should note that it is often hard to respond promptly to individual e-mail queries regarding the status of one's application for aid.

6.0 General School and University Policies on Graduate Studies

While conforming to the general policies on graduate studies that are set forth by the School of Engineering as well as the University of Pittsburgh, the Department of Industrial Engineering has certain additional policies of its own. These are described in detail in the Sections 8 and 9 for the MS and the Ph.D. program. For detailed university policies please refer to documentation available on-line at *http://www.pitt.edu/~graduate/policies.html*, and at *http://www.umc.pitt.edu/bulletins/graduate/engineering.htm* for details on School of Engineering policies.

7.0 Advising and Registration

The Department of Industrial Engineering is committed to allowing each student the freedom to pursue his or her research interests and to work with the faculty member of his or her choice. When a student first enrolls in the department, faculty advisors are assigned at random, or the graduate program director acts as the advisor. However, students are strongly encouraged to talk with other faculty members and to find out what kind of research projects they are involved with, so that they can make an intelligent decision on an advisor. It is every student's right to be able to work with any faculty member who is willing and able to accept the student as an advisee. Students are expected to choose an initial academic advisor by some time during the middle of their first term in the department. All students have the right to change advisors at any time.

7.1 Plan of Study

Initially, the graduate program director meets with each incoming student to review his/her background, and together the two decide on the courses that the student will register for in his or her first term. By the end of the first term each student is expected to have selected an advisor and together, they develop a tentative but complete plan of study for the entirety of the student's program. The department recognizes that this proposed plan may change over time, and the student is therefore not obligated to follow this plan exactly. However, it is something that is meant to help the student plan an academic program, and it is required that every student submit this plan of study by the end of the first term in the department. A form for this is available in the department office in 1048 Benedum Hall, and the completed form is placed in the student's files. It is the responsibility of the student and his or her advisor to update this plan as and when it becomes necessary to do so.

7.2 Registration and Course Load

All graduate students are expected to register for a full load of at least 12 credits (or four courses) per term.

7.3 Assistantship Duties

Students supported via full assistantships will be expected to work 20 hours per week on their assistantship duties. With research assistantships, it is possible that the work done by the student might be directly related to his or her dissertation; however, this is not always feasible and it might happen that the research for the assistantship and the dissertation are on different topics, and in rarer cases, that the faculty supervisor for the assistantship might not be the student's academic advisor.

8.0 Master of Science (M.S.) in Industrial Engineering

The Master's program may be completed with either a thesis option or a non-thesis option. In both cases the student is required to complete a minimum of 30 credits in coursework. This is in the form of ten 3-credit courses for the non-thesis option, and eight 3-credit courses plus a 6 to 8-credit thesis for the thesis option. In addition, any student who does not have an undergraduate degree in industrial engineering is required to take IE 2000, which is a 1-credit overview of the basics of industrial engineering.

The M.S. program is flexible and students may either choose to focus on one area, or opt for a more broad-based curriculum with course-work spanning multiple areas. A terminal Master's student who is awarded an assistantship is required to write a Master's thesis. This requirement is waived only if the student goes on to write a Ph.D. dissertation. The Master's program can be completed in 12 to 16 months of full-time study or two to three years of part-time study.

8.1 Requirements

Common Requirement:

IE 2000: FUNDAMENTALS OF INDUSTRIAL ENGINEERING (1 credit): Required for all students who do not have an undergraduate degree in industrial engineering.

Non-thesis option:

(1) Required Core (9 credits)

(a) IE 2001: OPERATIONS RESEARCH
(b) IE 2005: PROBABILITY & STATISTICS FOR ENGINEERS
(c) IE 2006: INTRODUCTION TO MANUFACTURING SYSTEMS

(2) Elective Core: at least two of the following (6 credits)

(a) IE 2003: ENGINEERING MANAGEMENT
(b) IE 2004: DATABASE DESIGN
(c) IE 2007: STATISTICS AND DATA ANALYSIS
(d) IE 2100: SUPPLY CHAIN ANALYSIS

(3) Another 15 Credits that can be freely chosen from the elective core or other graduate offerings in the department, based on the student's individual interests and in conjunction with the approval of his or her academic advisor. With the advisor's approval, up to 6 of these 15 credits may be obtained from other graduate offerings in the university or at another reputable university.

Thesis option:

(1) Required Core (9 credits)

(a) IE 2001: OPERATIONS RESEARCH
(b) IE 2005: PROBABILITY & STATISTICS FOR ENGINEERS
(c) IE 2006: INTRODUCTION TO MANUFACTURING SYSTEMS

(2) Elective Core: at least two of the following (6 credits)

(a) IE 2003: ENGINEERING MANAGEMENT
(b) IE 2004: DATABASE DESIGN
(c) IE 2007: STATISTICS AND DATA ANALYSIS
(d) IE 2100: SUPPLY CHAIN ANALYSIS

(3) Thesis (6 to 8 credits)

(4) Another 9 credits that can be freely chosen from the elective core or other graduate offerings in the department. No out-of-department electives are permitted with the thesis option.

Note: The Master's thesis must show marked attainment in one of the departmental concentration areas. Acquisition of the methods and techniques of scientific investigation must also be demonstrated. A faculty member knowledgeable in the student's area of interest (typically, the advisor) must supervise the thesis. The student is required to make an oral presentation to his or her thesis examining committee, which includes the advisor and at least two other departmental faculty members.

Graduate Seminar

Every full-time student must register for and attend IE 3095: GRADUATE SEMINAR during each term that he/she is a full-time student.

Students with an undergraduate degree in Industrial Engineering or with prior exposure to the courses in the core are expected to skip one or more of these courses. Courses that are skipped must be substituted with more advanced coursework in the same general area. The student's advisor and/or the graduate program director will make a determination of where this is appropriate.

8.2 Transfer Credits

Students may transfer up to 6 credits of graduate coursework taken at the University of Pittsburgh or another recognized institution, even if these courses have been used to fulfill requirements for another graduate degree (credits cannot be transferred if they have been counted against an undergraduate degree). However, such coursework **must** be relevant to Industrial Engineering and complement the student's program of study at the University of Pittsburgh. A determination of this will be made by the graduate program director and may require appropriate documentation of course content for this purpose. For the course credits to transfer the student must have obtained at least a "B" grade in these classes.

9.0 Ph.D. Program

This section first provides highlights of some relevant University policies, followed by departmental requirements. Once again, detailed University policies are available on-line at *http://www.pitt.edu/~graduate/policies.html*.

9.1 Highlights of General University Regulations

Residency Requirement: Students seeking the Ph.D. degree are required to engage in a minimum of one term of full-time doctoral study, which excludes any other employment except as approved by their departments.

Credit Requirements

- According to University regulations, at least 72 credits are required beyond the bachelor's degree (minimum credit requirement)
- If a student already has a Master's degree, no more than 30 credits may be accepted for a master's degree awarded by another institution to meet the minimum credit requirement, i.e., at least 42 credits are required beyond the master's degree.
- In recognition of graduate study *beyond* the master's degree successfully completed elsewhere, no more than 12 additional credits may be accepted at the time of admission to meet the minimum credit requirement.
- No more than 30 credits may be accepted for a previously earned Ph.D. degree in recognition of master's degree work.
- In all cases, at least three terms, or 36 credits, of full-time doctoral study or the equivalent in part-time study must be successfully completed at the University of Pittsburgh.

Preliminary Examination: The preliminary examination is designed to assess the breadth of the student's knowledge of the discipline, the student's achievement during the first year of graduate study, and the potential to apply research methods independently. The form and nature of the examination changes periodically. It is conducted at approximately the end of the first year of full-time graduate study. The examination is used to identify those students who may be expected to complete a doctoral program successfully and also to reveal areas of weakness in the student's preparation.

Comprehensive Examination: The Comprehensive Examination is designed to assess the student's mastery of the general field of doctoral study, the student's acquisition of both depth and breadth in the area of specialization within the general field, and the ability to use the research methods of the discipline. In some programs, the comprehensive examination is combined with the overview or prospectus meeting. It should be administered at approximately the time of the completion of the formal course requirements and should be passed at least eight months before the scheduling of the final oral examination and dissertation defense. In no case may the comprehensive examination be taken in the same term in which the student is graduated.

Overview or Prospectus Meeting: Each student must prepare a dissertation proposal for presentation to the doctoral committee at a formal dissertation overview or prospectus meeting. The overview requires the student to carefully formulate a plan and permits the

doctoral committee members to provide guidance in shaping the conceptualization and methodology of that plan. The doctoral committee must unanimously approve the dissertation topic and research plan before the student may be admitted to candidacy for the doctoral degree. Approval of the proposal does not imply either the acceptance of a dissertation prepared in accord with the proposal or the restriction of the dissertation to this original proposal.

Admission to Candidacy for the Doctor of Philosophy Degree: Admission to candidacy for the Doctor of Philosophy degree constitutes a promotion of the student to the most advanced stage of graduate study and provides formal approval to devote essentially exclusive attention to the research and the writing of the dissertation. To qualify for admission to candidacy, students must be in full graduate status, have satisfied the requirement of the preliminary evaluation, have completed formal course work with a minimum quality point average of 3.00, have passed the comprehensive examination, and have received approval of the proposed subject and plan of the dissertation from the doctoral committee following an overview or prospectus meeting of the committee. In some schools, admission to candidacy is a prerequisite to registration for dissertation credits. Students are informed of admission to candidacy by written notification from the dean, who also states the approved doctoral committee's composition.

Final Oral Examination: The final oral examination in defense of the doctoral dissertation is conducted by the doctoral committee and need not be confined to materials in and related to the dissertation. Any member of the Graduate Faculty of the University may attend and participate in the examination. The date, place, and time of the examination should be published well in advance in the University Times. Other qualified individuals may be invited by the committee to participate in the examination. Only members of the doctoral committee may be present during the final deliberations and may vote on the passing of the candidate. A report of this examination, signed by all the members of the doctoral committee, must be sent to the dean. If the decision of the committee is not unanimous, the case is referred to the dean for resolution. The chair of the doctoral committee should ensure that the dissertation is in final form before requesting signatures of the members of the committee.

9.2 Departmental Course Requirements

In accordance with the University regulations, a minimum of 72 credits is required beyond the undergraduate degree. Of these, at least 18 must come from research directed towards the doctoral dissertation. The student registers for IE 3997: Ph.D. RESEARCH prior to passing the proposal examination (see Section 9.7) and for IE 3999: DISSERTATION RESEARCH after the proposal has been accepted. At least 12 of the 18 credits must come from IE 3999, i.e., no more than 8 credits of IE 3997 can be counted towards this 18 credit requirement.

The minimum requirements are as follows (note that most Ph.D. students actually end up taking more credits than these minimum requirements):

- IE 2000: FUNDAMENTALS OF INDUSTRIAL ENGINEERING (1-cr.) is required for all students who do not have an undergraduate degree in Industrial Engineering

- Qualifying Core: 15 credits
  (1) IE 2081: LINEAR OPTIMIZATION
  (2) IE 2072: PROBABILITY
  (3) IE 2006: INTRODUCTION TO MANUFACTURING SYSTEMS
  (4) IE 2007: STATISTICS AND DATA ANALYSIS
  (5) IE 2084: STOCHASTIC PROCESSES

- Additional Required Coursework: 9 credits
  (1) IE 2003: ENGINEERING MANAGEMENT
  (2) IE 2100: SUPPLY CHAIN ANALYSIS
  (3) IE 2088: DIGITAL SYSTEMS SIMULATION
- Additional Elective Coursework: 30 credits
- Doctoral & Dissertation Research (IE 3997 and IE 3999): 18 credits

At least 6 out of the 30 elective credits must be taken (with the approval of the student's Advisor) from offerings outside the Department of Industrial Engineering. All students must also register each term for IE 3095: GRADUATE SEMINAR (1 cr.); however, these credits **cannot** be counted towards the total credit requirements.

As with the M.S. degree, students with sufficient prior exposure to a course (either at the undergraduate level or as part of a prior Master's program) are expected to skip such courses and replace them with more advanced coursework in the same general area. A determination of this is made by the advisor and/or the graduate program director.

9.3 Transfer Credits

Students may transfer a maximum of 30 credits of graduate coursework taken at a recognized institution as part of another Master's degree. A determination of what coursework is appropriate for transfer is made by the graduate program director; if the previous M.S. degree was not in Industrial Engineering the student will in general be able to transfer significantly fewer than 30 credits. The total credit requirements as well as specific courses that are required are unchanged for transfer students.

9.4 Preliminary Examination

This examination allows the department to assess the student's academic preparation, breadth of knowledge and potential to study and conduct research at the doctoral level. It is given once a year in early May immediately after the end of the Spring term and before classes start for the Summer term. The typical student who enrolls in Fall must take this examination after the first two terms in the program. Students who start in Spring have the option of taking the exam at the end of the term or waiting a year until the next May.

In order to appear in this examination, the student must submit an application in March; the appropriate form is available in the departmental office (1048 Benedum Hall). All applications are evaluated by the entire faculty who then make a decision on whether or not to approve the student's application. In order to be able to take the exam, a student is

expected to have a quality point average of 3.3 or better in graduate work and show promise for doing independent research. Currently, the examination is an oral one and covers the fundamentals of the following topics: (1) Linear Optimization, (2) Probability and Statistics, (3) Stochastic Processes, and (4) Manufacturing Systems and Basic Industrial Engineering. Each topic is assigned an examining committee comprising two to four faculty members, one of whom acts as the chair, and all students are examined by the same committees. A typical examination in each topic lasts for about 45 minutes during which time the committee members take turns asking questions. At the end of the oral exam the candidate is asked to leave the room and the committee spends time to arrive at a recommendation to present to the rest of the faculty. After all tests have been administered, the entire faculty meets (usually within two to three days) and discusses each candidate's performance along with the recommendations of the committees. Based upon the candidate's performance in the exam, his/her academic record, and the student's promise for doctoral research, the faculty votes to assign each candidate to one of three categories: (1) passing (either unconditionally or with certain accompanying requirements), (2) failing, but with permission to retake the test the following year (and possibly, conditional on meeting specified requirements), and (3) failing and not permitted to retake the exam. A student is allowed no more than two opportunities to take the preliminary examination and is admitted to Ph.D. candidacy only after he/she has passed this exam.

9.5 Examining Committee

After passing the preliminary examination, the doctoral candidate is expected to finalize the general area in which he/she will write a dissertation and an advisor who will guide the dissertation. The student is expected to take whatever additional courses are required to prepare for doctoral research and the dissertation. At the end of the student's second year in the program, the student's advisor and one or two other appropriate faculty members will review the student's academic record and plan of study to ensure that he/she has taken or will take all courses appropriate for the student's area of specialization/research. By some time during the early part of the third year the student (under the guidance of his or her advisor) is expected to appoint a committee consisting of the advisor and a minimum of three to four other members of the graduate faculty. At least two of the committee members should be from the Industrial Engineering Department and at least one from outside the department (including appropriate members from outside the University of Pittsburgh). This committee oversees the student's dissertation research and the remainder of his or her Ph.D. program; it will meet at least once each year (and more often if necessary) to follow the progress of the student and make recommendations.

9.6 Ph.D. Comprehensive Examination

The purpose of this examination (which is usually taken at the end of the student's second year or early in the third year) is to test the student's acquisition of breadth as well as depth in the area of specialization, and the ability to use research methods in his or her major area of interest. It is also used to identify any deficiencies in the student's background and suggest remedial work, and to test the student's ability to prepare an acceptable dissertation.

For the comprehensive exam, the student is required to write a high quality research paper. The paper is developed with the help of the student's advisor and may be on a topic that

eventually becomes part of the student's dissertation; however, it could also be on an independent topic. While he/she can receive some guidance and help from the advisor, the actual writing should be done by the candidate. The student is completely responsible for correct grammar and spelling, and when necessary, for seeking external help in this regard. The research paper should be written as though it is being submitted to a refereed journal and should follow the publication guidelines specified by that journal. The finished paper will be reviewed by two faculty members, neither of whom is the student's academic advisor and will also be available for the rest of the faculty to examine. Any recommendations made by the reviewers should be considered seriously and incorporated into a revision and ideally, this paper should then be submitted to the journal for publication.

9.7 Dissertation Proposal Examination

The purpose of this examination is to test the soundness and validity of the candidate's research topic, research plans, and methods that are described by the student in an oral presentation. Passing this examination provides the student with an affirmation by the committee that the proposed work when completed will lead to a Ph.D. dissertation. It is expected that the student will take the proposal examination within two and one half to three academic years after starting the doctoral program. For this examination, the student must write a proposal on the work proposed to be done for the student's Ph.D. dissertation. The proposal is required to follow the guidelines set for proposals submitted to the National Science Foundation (see *http://www.nsf.gov/pubs/2004/nsf042/2.htm* for details; a *pdf* copy of this also available in the department as well as on the departmental web-site). The length of the proposal is limited to fifteen single-spaced pages (thirty pages, double-spaced). It should also be accompanied by a one page executive summary that describes the intellectual merits and the broader impacts of the proposed work, and a comprehensive list of references. The proposal should be self-contained, but it may contain appendices where absolutely necessary.

The student should set up a time for the examination of at least 2 hours duration in consultation with the committee, and should give the committee copies of the written proposal at least 2 weeks before the examination unless a member agrees to accept it closer to the time of the exam. During the examination, the student makes a presentation - usually about 45 minutes in length if uninterrupted - covering the main items in the written proposal. The organization of the presentation may vary somewhat but often includes the following:

1. Introduction & Background
2. Research Objectives
3. Summary of Prior Work
4. Proposed Research Methodology
5. Preliminary Results
6. Tentative Time-Line

The committee may interrupt the presentation to ask questions or request a clarification. At the end of the presentation, each committee member in turn asks additional questions that they might have. The committee then makes recommendations for setting the correct scope for the research proposed and/or improving the same.

9.8 Dissertation Defense Examination

After the work on the dissertation and the dissertation document are completed, the student is required to defend his or her work in a final examination. The student should set up a time for the Ph.D. dissertation defense allowing at least 2 to 3 hours duration in consultation with the committee. The student should give the committee copies of the written dissertation at least 3 weeks before the defense unless the members agree to accept it closer to the time of the defense.

For this defense, the student makes a presentation - usually about 45 minutes to an hour in length if uninterrupted - covering the main conclusions of the dissertation research. The presentation is open to the public and anyone who is interested may attend. Anyone may interrupt the presentation to ask questions or request a clarification. At the end of the presentation, the committee chair first asks audience members who are **not** on the committee if they have additional questions. If they do, the candidate first answers all of these questions. Following this, the committee chair requests everyone except the committee members to leave the room and then each of the committee members takes turns asking the candidate questions. At the end of the defense, the student is asked to leave the room and the committee discusses the results of the defense and votes to pass or fail. If a student passes, the student finalizes the dissertation taking into account all requests by the committee for changes and receives the Ph.D. If the student fails, the student can repeat the defense once. However, this is very rare since the student's research advisor will not recommend that the student stand for the defense until he/she is ready. It is expected that the dissertation will lead to at least one paper of publishable quality in a respected technical journal.

9.9 Journal Paper

Prior to graduation all Ph.D. students are required to submit at least one article based on their research for publication in a refereed journal. The paper is typically a collaborative effort by the student and his/her advisor (and possibly, other students and/or committee members as well).

9.10 Ph.D. Program Time Table / Flowchart

The following table presents a typical time chart that students in the Ph.D. program should try to follow – reasonable variations from the schedule shown are entirely acceptable. A copy of this is placed in each student's academic folder for the benefit of the student and his/her advisor.

EVENT	TYPICAL TIME FRAME
Select an initial academic advisor	Middle of first term
Submit a tentative plan of study	End of first term (updated over time as necessary)
Finish taking qualifying core	By end of second term
Preliminary Exam	After end of second term
Teaching Practicum	During the second/third year
Review of Academic Record	End of second year
Paper for Comprehensive Exam	End of second year/Early in third year
Select Graduate Committee	During the third year
Proposal Exam	During the third year
Committee Meetings	At least once every academic year
Teaching Assignments	At least one; scheduled by department chair and/or graduate program director
Complete research and write the dissertation	Years four and/or five
Schedule dissertation defense	During fourth or fifth year
Submit dissertation to committee	At least three weeks before defense
Submit article(s) to refereed journal	Prior to the end of the last term
Apply for graduation	Last term, as required by the university
Submit final copy of thesis to the Engineering Administration Office, 253 BEH.	Schedule as per Engineering Administration.
Pay Microfilm / Binding fees.	Schedule as per Engineering Administration.
Submit bound copy of thesis to department office and committee members	End of last term

10.0 Thesis Formatting and Related Requirements

For detailed information on how the Ph.D. dissertation or M.S. thesis should be formatted, please consult the relevant web-site at *http://www.pitt.edu/~graduate/dissertation.html*. All committee members should be provided with a copy of the final M.S. thesis or Ph.D. dissertation. In addition, all students are required to submit a bound final copy to the department. This copy is placed in the department archives with the department chair and is accessible to any student or faculty member who wishes to look at the same. The final copy should be bound as required by the department – details are available with the departmental office in 1048 Benedum Hall.

11.0 Other Requirements

Every graduate student is required to register each term for IE 3095: Graduate Seminar. In addition, all Ph.D. students have a teaching obligation to the department. Students who are supported via assistantships may use their assistantship assignments to count for this, and the department chair and/or graduate program director have the responsibility of making these assignments.

11.1 Seminar Duties

Typically, seminars are held every Thursday afternoon and attendance is mandatory. In order to provide for refreshments during the period prior to the seminar all full-time graduate students must take their turn in helping to set-up for the seminar and clean-up afterwards. Responsibilities for graduate students assigned to seminar duty and a list of graduate students assigned to seminar duty for the current term are available with the Graduate Secretary in 1048 BEH.

12.0 Residency Requirements and Statute of Limitations

Full-time residency is highly desirable in a graduate program. However, the School of Engineering recognizes the need for part-time study by persons employed in industry and allows accumulation of a portion of graduate credits on a part-time basis. The following rules typically apply for residency:

a. Full-time residency is not required for the MS program.

b. As per University regulations, all candidates for the PhD degree must engage in at least one term of full-time doctoral study at the University.

All members of the teaching, technical, and administrative staffs of the University, all holders of scholarships, assistantships and fellowships are considered in full residence during the period of their graduate study. For students employed full-time in industry, early planning of the academic-year leave of absence from their employment is strongly advised. The planning and arrangement with the employer for leave is the responsibility of the student.

12.1 Statute Of Limitations

Requirements for the MS degree must be completed within a period of four consecutive calendar years from the student's initial registration for graduate study. Requirements for the PhD must be fulfilled within a period of ten calendar years from the student's initial registration for graduate study; or, for the student holding an MS degree, within a period of eight calendar years from the first registration for graduate study following the receipt of the MS degree. Except for time spent in the Armed Forces, the elapsed time after the student's initial registration will count toward the statute of limitations whether a student continues to register or not. Under extenuating circumstances, a student may request extension of the statute of limitation by writing to the department chairperson with the advisor's approval. Extension is not granted as a matter of course; a student requesting extension should clearly state the circumstances, period of extension sought, and present evidence that the factors causing the program's delay no longer exist. The department, in turn, will consider the circumstances, the evidence of diligence shown in fulfilling degree requirements, and the major advisor's recommendation, and then grant or reject the request. In no case is an extension granted simply to prolong a student's graduate study.

13.0 Application for Graduate Degree

An application for a graduate degree must be filed during the term in which the student expects to graduate. The application should be filed as early as possible to prevent payment of a late fee. No applications for graduation will be accepted after the end of the late application period. Application forms may be obtained in the departmental office. The student is advised to check with the Engineering Administration Office concerning the timing of this application. If a student is uncertain about completing work in the current term, the application should still be filed. If graduation is possible, a graduate degree application should be filed since it can be withdrawn, whereas an application after the late fee deadline will not be accepted. A new application must be filed for the term in which a student expects to graduate, even if an application for graduation was filed in a previous term.

All graduate students must be registered during the term of graduation. In special circumstances where only minimal work is required to complete the thesis or dissertation, a student may request a waiver for one term only.

M.S. Study Plan

Non-Thesis Option

NOTES

- **IE 2000 is required for all students without undergraduate IE degrees; optional for others**
- **IE 3095: GRADUATE SEMINAR is required each term for all full-time students**
- **Total of at least ten courses (30 credits) not counting IE 2000, IE 3095**
- **No more than 2 courses from outside the IE Department can count towards the 30 credits**

Course	Y	N	Advanced Substitute if N	Cr.	Grade	Term
IE 2000: FUNDAMENTALS OF INDUSTRIAL ENGINEERING (F)						
Required Core						
IE 2001: OPERATIONS RESEARCH (S)						
IE 2005: PROBABILITY & STATISTICS FOR ENGINEERS (F)						
IE 2006: INTRODUCTION TO MANUFACTURING SYSTEMS (F)						
Elective Core (at least two)						
IE 2003: ENGINEERING MANAGEMENT (S)						
IE 2004: DATABASE DESIGN (S)						
IE 2007: STATISTICS AND DATA ANALYSIS (S)						
IE 2100: SUPPLY CHAIN ANALYSIS (F)						
Other Electives						

TOTAL No. of Credits:

M.S. Study Plan

Thesis Option

NOTES

- **IE 2000 is required for all students without undergraduate IE degrees; optional for others**
- **IE 3095: GRADUATE SEMINAR is required each term for all full-time students**
- **6-8 credits of IE 2999: MS THESIS**
- **Total of at least eight courses (24 credits) not counting IE 2000, IE 3095, IE 2999**
- **No courses from outside the IE Department are permitted**

Course	Y	N	Advanced Substitute if N	Cr.	Grade	Term
IE 2000: FUNDAMENTALS OF INDUSTRIAL ENGINEERING (F)						
Required Core						
IE 2001: OPERATIONS RESEARCH (S)						
IE 2005: PROBABILITY & STATISTICS FOR ENGINEERS (F)						
IE 2006: INTRODUCTION TO MANUFACTURING SYSTEMS (F)						
Elective Core (at least two)						
IE 2003: ENGINEERING MANAGEMENT (S)						
IE 2004: DATABASE DESIGN (S)						
IE 2007: STATISTICS AND DATA ANALYSIS (S)						
IE 2100: SUPPLY CHAIN ANALYSIS (F)						
MS Thesis credits						
IE 2999: M.S. Thesis						
IE 2999: M.S. Thesis						
IE 2999: M.S. Thesis						
Other Electives						

TOTAL No. of Credits:

Ph.D. Study Plan

NOTES

- **IE 2000 is required for all students without undergraduate IE degrees; optional for others**
- **IE 3095: GRADUATE SEMINAR is required each term for all full-time students**
- **At least 6 credits must be from outside of I.E.**
- **Total of at least 54 credits in course work (not counting IE 3095 credits)**
- **Total of at least 18 credits of IE 3997 (prior to proposal being accepted) and IE 3999 (after proposal is accepted) combined, of which at least 12 must be from IE 3999**

Course	Y	N	Advanced Substitute if N	Cr.	Grade	Term
IE 2000: FUNDAMENTALS OF INDUSTRIAL ENGINEERING (F)						
Qualifying Core						
IE 2001: LINEAR OPTIMIZATION (S)						
IE 2072: PROBABILITY (F)						
IE 2006: INTRODUCTION TO MANUFACTURING SYSTEMS (F)						
IE 2003: ENGINEERING MANAGEMENT (S)						
IE 2007: STATISTICS AND DATA ANALYSIS (S)						
Required Courses						
IE 2100: SUPPLY CHAIN ANALYSIS (F)						
IE 2084: STOCHASTIC PROCESSES (S)						
IE 2088: DIGITAL SYSTEMS SIMULATION						
Out-of-department electives (at least 6 credits)						

Other Courses	Cr.	Grade	Term
Research Credits (IE 3997/3999)			

Ph.D. Checklist

EVENT	Check	DATE(S)
Select initial academic advisor		
Submit tentative plan of study		
Complete qualifying core courses		
Preliminary exam		
1523815238Review of academic record		
Paper for comprehensive exam		
Review of paper by at least two other faculty members		
Select graduate committee		
Proposal exam		
Committee meetings		
Departmental teaching obligation		
Complete dissertation		
Schedule dissertation defense		
Submit dissertation to committee		
Submit article(s) from dissertation research a to refereed journal		
Apply for graduation		
Submit final copy of dissertation to the Engineering Administration Office, 253 BEH.		
Pay Microfilm / Binding fees.		
Submit bound copy of thesis to department office and committee members		