Industrial Engineering

MS Graduate Handbook

2013 - 2014

ARIZONA STATE UNIVERSITY

MANUAL OF THE MS DEGREE IN INDUSTRIAL ENGINEERING

ARIZONA STATE UNIVERSITY

2013 – 2014

IE graduate degrees please contact:

Office of Graduate Programs
School of Computing, Informatics, and Decision Systems Engineering
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E-mail address: cidse.advising@asu.edu

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I. Introduction to the Industrial Engineering Program

The Industrial Engineering (IE) Program of Arizona State University (ASU) offers two graduate degrees: Master of Science (MS) with a thesis or non-thesis option and the Doctor of Philosophy (Ph.D.). The MS degree requires a written and an oral defense of the thesis or a final written Comprehensive Exam covering the core courses. The Ph.D. degree is offered to students who have completed a Bachelor's or Master's degree in engineering, or a closely related field, with distinction. It requires a qualifying exam, written dissertation and an oral defense of the dissertation.

II. Objective of the handbook

The purpose of this handbook is to provide guidance and information related to admission, degree requirements, and general policies and procedures. Please note that in some cases you will find differences between the Graduate Policies and Procedures and the Industrial Engineering Program requirements. In these cases, IE has established higher standards. Students must satisfy both sets of requirements. Please note that policies and procedures are occasionally amended to improve the program. Changes will be communicated to students through email, and posting on paper and online bulletin boards.

III. Student responsibility

All students are expected to become familiar with university and program policies and procedures and abide by the terms set forth. Information is available both online and by hardcopy upon request. Most importantly you should visit the following websites:

- The Office of Graduate Education – http://graduate.asu.edu .
- The Graduate Catalog – www.asu.edu/catalog visit the section on policies and procedures.
- The Industrial Engineering Program – http://cidse.engineering.asu.edu/forstudent/graduate/industrial-engineering/
- The International Student Office – https://international.asu.edu/ , if applicable.
- The Ira A. Fulton Schools of Engineering – http://engineering.asu.edu

IV. Faculty responsibility

The members of the faculty of Industrial Engineering have diverse backgrounds and knowledge. They are available to assist you in your plan of study and your educational and career goals. We encourage you to take the opportunity to make individual appointments with faculty members with whom you have common interests. Please refer to the list of the faculty names, areas of expertise, and research interest at the end of this handbook.

V. Admission and eligibility to the MS degree programs

The Industrial Engineering MS degree requires a background in engineering, math, statistics, sciences or closely related fields. However, in some cases students with non-traditional educational backgrounds will be considered for admission. These students may be required to take foundational courses to better prepare for the graduate coursework. A student is encouraged to contact a graduate advisor in the School of

Computing, Informatics, and Decision Systems Engineering Advising Center to obtain advice on their educational pursuits.

Eligibility - Prior to applying to the IE MS program, students are required to have completed three semesters or 12 credit hours of Calculus including Multivariate Calculus.

Application - All students are required to submit an application with the Office of Graduate Education and pay the required fee in order to have their application properly processed.

Application deadlines - January 15 for Fall and September 15 for Spring:
To receive full consideration, we ask that you have all the required documents submitted by the deadline.

GRE scores - All students are required to submit official **general** Graduate Record Examination (GRE) scores directly to the Office of Graduate Education. The average scores for students admitted into the MS program have been 500 verbal, 750 quantitative and 4.0 analytical. However, we do not require specific subject GRE scores.

TOEFL - The University requires all international applicants from a country whose native language is not English to provide the Test of English as a Foreign Languages (TOEFL) or the International English Language Testing System (IELTS) scores. Industrial Engineering Program uses 575 (paper-based) or 90 (internet-based) as minimum expectations for admission. **Please note that your application will not be processed until the university receives official TOEFL scores, which are valid two years from the start date of the degree program.** There are some exceptions for students who have been living in the United States and would like to have the TOEFL waived. They should consult the Office of Graduate Education. Please address all TOEFL questions to the Office of Graduate Education.

Personal statement - Applicant must submit a personal statement that indicates professional goals and reasons for desiring to enroll in the /MS programs**.**

Letters of recommendation - IE requires three (3) letters of recommendation, at least one of which must come from former faculty. There is no standard form for letters of recommendation. Our current application process allows students to submit the letter of recommendations electronically by indicating the names and the e-mails of the recommender. In turn, the Office of Graduate Education sends an e-mail to the recommender alerting him or her to go online and submit a recommendation. We encourage letters from people who know you well, such as teachers, professional associates and supervisors. Ask people who can comment on your academic, emotional, intellectual and professional development.

GPA requirement - To be considered for the MS program, we require a minimum cumulative GPA of 3.2 in the last 60 credit hours of the undergraduate degree.

Application evaluation - Several factors are taken into consideration when evaluating a student's application: the student's cumulative GPA, major, institution, personal statement, letters of recommendation, standardized test scores, and performance in individual courses.

Deficiencies - Depending on prior academic preparation and accomplishments of an applicant, deficiency courses may be specified to ensure adequate background preparation. During advising, a student may have their course syllabi examined as evidence that deficiencies have been satisfied or may choose to take the deficiency test-out examination. Please note that deficiencies are not intended solely as prerequisites for graduate coursework; they also satisfy the breadth requirement for all graduates of IE.

Deficiency test-out exam - On the day before orientation in Fall and Spring semesters, a classroom will be set aside to allow students entering with deficiencies (listed in the admissions letter) to take a brief test to establish whether they possess basic knowledge of the course sufficient to have an assigned deficiency waived. There are no exams available for CSE 110 and CSE 205. The deficiency test-out exam is open-book and the allotted time for each test is 50 minutes. Students may take up to 3 test-out exams. This scheduled testing period is the only opportunity for deficiency test-outs. No other arrangements will be made for students to test-out of assigned deficiencies.

Below is a list of prerequisites along with the associated ASU course numbers:

- CSE 110 – Principles of Programming in Java
- CSE 205 – Object-Oriented Programming and Data Structures
- MAT 242 – Linear Algebra
- IEE 380 – Probability and Statistics for Engineering Problem Solving
- IEE 385 – Engr Statistics - Probability
- IEE 470 – Stochastic Models
- IEE 376 – Deterministic Operations Research

Deficiency coursework completed with a grade of "C" or better at the undergraduate level will satisfy the requirements. A grade of "B" or better is required for all assigned deficiency coursework at the post-baccalaureate level.

Notice of Admission - IE submits its recommendation of admission to the Office of Graduate Education and the final notice of admission decision is notified in writing by the Office of Graduate Education. You may check your application status on My ASU (my.asu.edu).

Pre-admission credits and Transfer credit – Please refer to the Office of Graduate Education policies and procedures.

VI. MS degree requirements

A minimum of 30 credit hours of coursework beyond the bachelor's degree and deficiency courses are required to complete the MS degrees. All Master's students are required to develop and submit a Plan of Study (POS) through online ASU Interactive prior to pre- registering for courses for the upcoming semester. The POS should be

developed with the aid of the student's faculty advisor. Failure to file the POS on time will delay getting clearance for advising and the ability to register. The IE Graduate Academic Advisor, acting on behalf of the Graduate Program Chair, will initially advise the student. Subsequently, each student should seek out a faculty member in his or her area of study to serve as advisor and committee chair.

Assigned deficiency courses must be completed by the end of the 12th semester hour. A "B" or better average is required for deficiency courses, and a "B" must be achieved in each course. A grade of "B" or better in a course that follows a prerequisite class does not waive this requirement.

Degree requirements, area of study courses, and comprehensive exams are defined below.

The four **core courses** from the courses listed below **must be completed** by **the end of the 18th semester** hour applied to the Plan of Study (four of the first six POS classes). The four core courses include of a course in Information Systems, a course in Simulation, a course in Industrial Statistics, and a course in Operations Research. These courses are intended to expose the student to the fundamental topics across the IE spectrum. A grade of "C" or better must be achieved in each core course. Please note the core is not intended solely as prerequisites for following coursework; it also satisfies the breadth requirement for all graduates of our program.

1. IEE 505 – Information Systems Engineering or
   IEE 598 – Design of Computational Systems (IEE 506 permanent course)

2. IEE 545 – Simulating Stochastic Systems

3. IEE 572 - Design of Engineering Experiments or
   IEE 578 – Regression Analysis

4. IEE 574 – Applied Deterministic Operations Research Models
   IEE 575* – Stochastic Operation Research (*Students with IEE 470 deficiency, can take IEE 575/598 to waive the deficiency, but will not be able to count towards the core requirement. Instead it will count towards the area or elective).

BS/MS Accelerated Program Students (4+1) core requirements

1. IEE 505 – Information Systems Engineering or
   IEE 598 – Design of Computational Systems (IEE 506 permanent course)

2. IEE 561 – Production Systems

3. IEE 572 - Design of Engineering Experiments or
   IEE 578 – Regression Analysis

4. IEE 574 – Applied Deterministic Operations Research Models

Four area courses form one of the defined areas of study – Operation Research (OR), Production Systems and Logistics (PSL), Information Management & Systems (IMS), Industrial Statistics (IS).

Two elective courses, 500-level or above: Elective courses taken from other departments are encouraged, but must be approved by the student's faculty advisor. Either IEE 541, 543 or 547 is permitted as an elective with approval of the student's advisor.

Comprehensive Examination (Non-Thesis Option): A written Comprehensive Examination covering the student's core classes must be taken no later than the first exam date **immediately** following completion of the four core courses. Students must achieve a 70% or higher score on the Comprehensive Exam in order to graduate. Comprehensive Examinations are held once each semester (Spring and Fall). **The Comprehensive Exam cannot be waived.** Eligibility requirement to sit for the Comprehensive Exam: A student must have a cumulative grade-point-average (GPA) of 3.0 over all coursework, 3.0 over all graduate coursework, 3.0 over all POS courses, and have completed all the deficiency courses with a grade of "B" or higher to take the Comprehensive Exam. Review of comprehensive examination grading is allowed for a two-week period following the posting of results. This will be coordinated through the graduate academic advisor. No review will be allowed after two weeks.

A student who fails the comprehensive examination must petition for re-examination and receive approval from the supervisory committee, IE Program Chair, and the Office of Graduate Education Dean before the date of the examination. A student is allowed to retake the examination one time only in the test period immediately following the period in which the first examination was taken. If the student's petition for re-examination is not approved or the student fails the re-examination, the department will recommend to the Office of Graduate Education to withdraw the student from the MS program.

MS Thesis Option: Students writing a 6-hour thesis (MS Degree) can reduce area course requirements by one course and eliminate one elective course, or they may alternatively eliminate two elective courses, but in either case must complete 24 hours of 500 level or higher courses. A minimum GPA of 3.2 is required in the first 18 POS hours to pursue the MS thesis option.

MS students writing a thesis require a research advisory committee comprised of at least three faculty members including the committee chair. The two additional members are chosen jointly by the committee chair and the student to facilitate the student's research. A least one additional member should be from the IE faculty. Please refer at the back of the handbook for a list of area faculty and their research.

For MS students, the thesis and a successful oral defense constitute their final examination. A majority pass vote by the student's committee is required. For visa reasons, international students have a maximum of two semesters to finish the thesis after completion of coursework listed in the POS.

Steps to Preparing for Your MS Defense:

Prior to defense:

1. Obtain a consensus of approval from the committee chair and the committee members to proceed with the oral defense.
2. Schedule a date and time with your committee for the oral defense on MyASU.
3. Important: Ensure that a minimum of 50% of the official committee be physically present at the defense. If at least 50% of the committee cannot be physically present, the defense must be rescheduled.
4. Visit the Office of Graduate Education website to familiarize yourself with the dates and deadlines on format approval.

10 days prior to the defense: These steps are required to be complete prior to 10 working days from the date of oral defense.

1. Reserve a room with the CIDSE administrative office (Brickyard 5th Floor).
2. Submit an electronic version of your abstract with title, full names of your committee members, defense date/time/place, and your name as you want it to appear on the defense announcement to the CIDSE Advising Center front desk (Brickyard Room 208).
3. Schedule your defense with the Office of Graduate Education.

On the day of the defense:

1. Set-up all your equipment at least one half-hour prior to your presentation to make sure they work properly.

After the defense:

1. Your committee will have comments and a discussion with you. At the end, the committee makes a recommendation: Pass, Pass with minor revisions, Pass with major revisions, or Fail.
2. Revisions are normal and are expected to be completed within one year period. This includes remaining registered until the finished document has been uploaded through MyASU on ProQuest.
3. Hand-deliver a copy of your Thesis Defense Report form to the CIDSE Advising Center (BYENG 208).
4. Hand-deliver the signed Thesis Defense Report form to the Office of Graduate Education.
5. Follow the steps on MyASU on uploading your final dissertation through Office of Graduate Education and ProQuest.

VII. General Information

A. Academic Commendation: In any semester in which a student achieves an overall 3.75 or higher GPA on six or more credit hours of Plan of Study courses while in good standing, the School will send a letter notifying the student of being placed on that semester's list of students receiving Academic Commendation. The list of students receiving Academic Commendation is forwarded to the Dean's Office of the Ira A. Fulton Schools of Engineering.

B. Research Standards for Publication of Thesis

Graduate research is the study of an issue that is of sufficient breadth and depth to be publishable in an IE-related journal. The effort should reflect a minimum of 750 hours of thoughtful work for a thesis (M.S.). The research should follow the 'scientific method' and thus be both objective and reproducible. The thesis should demonstrate independent, original, and creative inquiry. There should be predefined hypotheses or developmental goals and objectives that are measurable and can be tested. The document should demonstrate proficiency with written English and should conform to the Office of Graduate Education format guidelines. For more information on format guidelines, please visit the Office of Graduate Education web site http://graduate.asu.edu

C. Financial assistance and/or fellowships

There are limited funds for MS students. We encourage students to pursue assistantships outside the IE and not limit their search to IE.

D. Continuous Enrollment and Leave of Absence Policies

Once admitted to a graduate degree program, master and doctoral students must be registered for a minimum of one credit hour (not audit) during all phases of their graduate education. This includes periods when they are engaged in research, working on or defending theses or dissertations, taking comprehensive exams, or in any other way using university facilities or faculty time including the term in which they graduate. This credit must appear on the *Plan of Study* or must be an appropriate graduate-level course (e.g. 595, 695, or 795, Continuing Registration). Courses with grades of "W" and "X" are not considered valid registration for continuous enrollment purposes.

Students planning to discontinue enrollment for a semester or more must request approval for a leave of absence. Students may petition the Office of Graduate Education for a leave of absence for a maximum of two semesters during their entire program. A petition for a leave of absence, endorsed by the members of the student's supervisory committee and the head of the academic unit, must be approved by the Office of Graduate Education dean. This request must be filed and approved before the anticipated absence.

An approved leave of absence will enable students to re-enter their program without re-applying to the university. Students who do not enroll for a fall or spring semester without an approved leave of absence by the Office of Graduate Education are considered withdrawn from the university under the assumption that they have decided to discontinue their program. A student removed for this reason may reapply for admission to resume their degree program; the application will be considered along with all other new applications to the degree program.

A student on leave is not required to pay fees, but in turn is not permitted to place any demands on university faculty or use any university resources.

E. Maximum Time Limit

All work toward a MS degree must be completed within **six consecutive years**. The six years begins with the semester and year of admission to the program. Graduate courses

taken prior to admission that are included on the *Plan of Study* must have been completed within three years of the semester and year of admission to the program.

F. Registration requirements for research assistants (RA) and teaching assistants (TA)
Students awarded an assistantship within the Ira A. Fulton Schools of Engineering are required to be registered for 12 credit hours (no more, no less). Audit credit hours do not count towards the 12 credit hours.

Students who obtain an assistantship outside the Ira A. Fulton Schools of Engineering are required to follow the policy of the unit that hires them.

TAs and RAs are treated as residents for tuition purposes. To be eligible for tuition remission, TAs and RAs must be employed a minimum of 10 hours per week (25 percent Full Time Equivalency {FTE}). TAs/RAs working 10-19 hours per week (25-49 percent FTE) receive a 50 percent remission of tuition for the semester or summer session of their employment. TAs/RAs working 20 hours per week (50 percent FTE) do not pay tuition during the semester or summer session of their employment. In addition, the university pays the individual's health insurance premium for those TAs and RAs working 20 hours per week (50 percent FTE).

G. Satisfactory Progress, Academic Probation, Progress probation, and Withdrawal from the IE Program: Each semester, the Industrial Engineering Program reviews students' files for satisfactory progress towards completion of the degree. All students are placed on one of the four categories:

1. Satisfactory progress
2. Academic Probation
3. Progress probation
4. Withdrawal from the IE Program.

1. Satisfactory progress means that the student does not have any academic and progress probationary issues. In addition to the probationary rules, satisfactory progress includes communication each semester with the student's Committee Chair regarding his or her progress.

2. Academic Probation pertains to grades that might affect Program and University policies including graduation. The following are notices/letters you will receive if one of these pertains to your academics*:*

- GPA below 3.0 in approved POS courses.
- Overall post baccalaureate GPA below 3.0.
- Overall graduate (500 level or above) GPA below 3.0.
- Received a "D" or "E" in a required deficiency course or in a course at the 400 level or above.
- Deficiency GPA below 3.0.

3. Progress probation pertains to issues dealing with making progress towards a

degree. The following are notices/letters you will receive if one of these pertains to your academics:

- Lack of Progress toward removing deficiencies as listed on your admission letter.
- Lack of Progress toward completing the four Core courses within the first 18 hours of POS courses.
- Failure to pass the Comprehensive Examination.

4. A student is recommended for **withdrawal from the IE Program** if she or he fails to meet the probationary standards placed upon in the semester mentioned in the probationary letter. The student will receive a letter from the Industrial Engineering Program explaining the reasons for the withdrawal. The student will have 7 calendar days from the date of the letter to appeal the decision. The IE Graduate Affairs Committee (GAC) will review the case and will make the necessary recommendation. The Graduate Program Chair, on behalf of the GAC, will provide a written explanation of the outcome. If the outcome is favorable, the student will have to meet all the outlined requirements at the end of the specified period. The student will be required to sign an agreement acknowledging the recommendations and the consequences if the agreements are not met. If the GAC recommends that the appeal is not granted in favor of the student, the Graduate Program Chair, on behalf of the GAC, will recommend to the Dean's Academic Affairs to withdraw the student from the IE Program. The student will then have the opportunity to appeal to the Ira A. Fulton Schools Standards Committee which reviews the student's case and makes the final ruling to Associate Dean and the IE Program. If the appeal is not granted in favor of the student, the Dean's Academic and Student Affairs will recommend to the Office of Graduate Education to withdraw the student from the IE MS Program. Please refer the Office of Graduate Education catalog on policies and procedures or contact the graduate advisor in the CIDSE Advising Center.

H. Academic Integrity

The highest standards of academic integrity are expected of all graduate students, both n the academic coursework and in their related research activities. The failure of any graduate student to meet these standards may result in serious consequences including suspension or expulsion from the university and/or other sanctions as specified in the academic integrity policies of individual colleges as well as the university.

Violations of academic integrity include, but are not limited to: cheating, fabrication, tampering, plagiarism, or aiding and/or facilitating such activities. At the graduate level, it is expected that students are familiar with these issues and each student must take personal responsibility in their work. In addition, graduate students are expected to follow university guidelines related to the Student Code of Conduct. University policies related to academic integrity and code of conduct are available in the Office of Graduate Education, or at http://graduate.asu.edu/beintheknow .

I. IEE 584 - Internship

Graduate Internship is intended as a unique, new learning experience, apart from a regular engineering employment position. Therefore, it is not available to full or part-time workers regularly employed by the company where the internship is proposed. An internship cannot be done if all other class work has been completed, as the Internship Program is designed so that the practical experience gained will enhance the classroom learning experience.

IEE 584 Internship is for one (1 hour) credit hour per semester and typically limited to one semester. In special cases a total of two enrollments with one in Spring or Fall semester and one in summer session will be considered. A student may work full-time (40 hours) in a summer session and part-time (20 hours) in a Fall or Spring semester. Students are advised to consult with their academic advisor when formulating a Plan of Study.

An approved proposal is required before commencing the internship. The request will include a statement from the employer that indicates they understand that the work is to satisfy a degree requirement. A sample letter and other required forms are available from the Graduate Advisor. Students must receive approval from their faculty advisor and from the Graduate Program Director before registering for IEE 584. In order to register for IEE 584, a student must have a GPA of 3.20. A final Plan of Study must be filed with the Office of Graduate Education showing the Internship course before registering for IEE 584. All application materials for an Internship must be completed by the last day of regular registration for any semester. The student must take classes appearing on the Plan of Study the semester following the internship.

Renege: (verb) to fail to carry out a promise or commitment

Never accept a job with the intention of turning it down if "something better" comes along. Not only is it inconsiderate and unprofessional, it also reflects badly on Arizona State University and might negatively impact another ASU student's opportunities with that employer. Also, employers communicate with each other and you don't want to get a bad reputation.

After you have given your decision careful consideration and accepted an offer, stop looking. Inform other employers who have extended offers that you have accepted another position. Don't accept further interview invitations or search further. Please refer to NACE's Playing Fair…Your Rights and Responsibilities as a Job Seeker http://www.naceweb.org/playing_fair/ to become familiar with Principles for Professional Practice.

A five-page final report is required before a grade and credit is given. The final report must be submitted to the reporting supervisor for comments and then to the faculty advisor for grade assignment.

J. IEE 590 Reading and Conference

IEE 590 Reading and Conference (Independent Study) is available for /MS students. The student cannot combine IEE 590, 584, and 581 as part of the Plan of Study. The student must get written approval from the supervising faculty outlining the coverage of the content. The Independent Study form must be approved by the Graduate Program Chair will be placed in the student's file.

K. Student chapters of professional societies

Our graduate students are involved in many professional societies. Most branches of Industrial Engineering have professional societies associated with them. Participation in professional societies is an excellent road to career and interest group connections. Student membership typically costs less than $30 and includes many benefits including a monthly magazine. Professors will be happy to sign a membership form that will entitle a student to reduced rates. The professional society for all areas of Industrial Engineering is the Institute of Industrial Engineers (IIE). The ASU student chapter of IIE was the first student chapter formed in the Industrial Engineering Program and has a long history including many chapter awards. In 1999, a new student chapter of INFORMS, an operations research and management science professional society, was formed at ASU.

Concentration Areas of IE Graduate Courses

COURSE	TITLE	OR	PSL	IMS	IS
IEE 505	Information Systems Engineering (3)			X	
IEE 511	Analysis of Decision Processes (3)	X	X	X	X
IEE 512	Introduction to Financial Engineering (3)	X	X	X	
IEE 520	Statistical Learning for Data Mining (3)			X	X
IEE 521	Urban Operations Research (3)	X			
IEE 526	Operations Research in Healthcare (3)	X			
IEE 530	Enterprise Modeling (3)			X	
IEE 532	Management of Technology (3)			X	
IEE 533	Scheduling (3)	X	X		
IEE 534	Supply Chain Modeling and Analysis (3)	X	X		
IEE 535	Introduction to International Logistics Systems (3)		X		
IEE 541	Engineering Administration (3)			X	
IEE 545	Simulating Stochastic Systems (3)	X	X		
IEE 552	Strategic Technological Planning (3)			X	
IEE 556	Introduction to Systems Engineering (3)			X	
IEE 561	Production Systems (3)		X		
IEE 563	Distributed Information Systems (3)			X	
IEE 564	Planning for Computer-Integrated Manufacturing (3)			X	
IEE 566	Simulation in Manufacturing (3)		X		
IEE 567	Simulation system Analysis (3)		X		
IEE 570	Advanced Quality Control (3)			X	X
IEE 571	Quality Management (3)				X
IEE 572	Design of Engineering Experiments (3)				X
IEE 573	Reliability Engineering (3)				X
IEE 574	Applied Deterministic Operations research Models (3)	X	X		
IEE 575/598	Applied Stochastic Operations Research Models (3)	X	X		
IEE 576	Modeling & Analysis of Semiconductor Manufacturing Operations (3)		X		
IEE 577	Advanced Information System Operations (3)			X	
IEE 578	Regression Analysis (3)				X
IEE 579	Time Series Analysis and Forecasting (3)				X
IEE 581	Six Sigma Methodology (3)				X
IEE 582	Response Surfaces and Process Optimization (3)	X		X	X
IEE 605	Foundations of Information Systems Engineering (3)			X	
IEE 620	Optimization I (3)	X			
IEE 622	Optimization II (3)	X			
IEE 640	Probability & Stochastic Processes (3)	X			
IEE 670	Mathematical Statistics (3)				X
IEE 672	Advanced Topics in Experimental Design (3)				X
IEE 677	Regression and Generalized Linear Models (3)				X
IEE 679	Time Series Analy/Control (3)				X
IEE 598	Design of Computational Systems			X	
IEE 598	Network Flows	X	X		
BMI 501	Intro to Biomedical Informatics				X
BMI 502	Foundations of BMI Methods I				X
CSE 520	Computer Architecture II (3)			X	
CSE 534	Advanced Computer Networks (3)			X	

COURSE	TITLE	OR	PSL	IMS	IS
CSE 536	Advanced Operating Systems (3)			X	
CSE 550	Combinatorial Algorithms and Intractability (3)	X		X	
STP 427	Mathematical Statistics (3)	X			X
STP 526	Theory of Statistical Linear Models (3)				X
STP 532	Applied Nonparametric Statistics (3)				X
STP 533	Applied Multivariate Analysis (3)				X
STP 534	Applied Discrete Data Analysis (3)				X
MAT 523	Numerical Optimization (3)	X			

OR = Operations and Research
PSL = Production Systems
IMS = Information & Management Systems
IS = Industrial Statistics

SPECIAL PROGRAM

ENGINEERING LOGISTICS – Supervising faculty: Drs. Esma Gel and Rene Villalobos.
Four core courses

Refer to page 4

Other required classes:

IEE 534 Supply Chain Modeling and Analysis. (3)
IEE 535 Introduction to International Logistics Systems. (3)

Two courses from the following list:

IEE 530 Enterprise Modeling. (3)
IEE 533 Scheduling and Network Analysis Models. (3)
IEE 561 Production Systems. (3)
IEE 567 Simulation System Analysis. (3)
IEE 574* Applied Deterministic Operations Research Models. (3
IEE 575* Applied Stochastic Operations Research Models. (3)
IEE 598 – Warehousing and Material Handling

Two more elective course or Research and Thesis

* These courses may be used as area or core courses but not both.

Industrial Engineering Faculty
Course Descriptions

IEE 505 Information Systems Engr
Studies information systems application engineering.
Topics include information technology, data modeling, data organization, process mapping, application and database engineering, and user interface development. Prerequisite: CSE 205

IEE 511 Analysis of Decision Processes
Methods of making decisions in complex environments and statistical decision theory; effects of risk, uncertainty, and strategy on engineering and managerial decisions. Prerequisite: IEE 380

IEE 512 Introduction to Financial Engineering
Introductory course on financial engineering covering traditional portfolio theory, forwards, futures, financial stochastic models, option pricing, and risk management. Prerequisite: Graduate Standing

IEE 520 Statistical Learning for Data Mining
Surveys data analysis methods for massive data sets and provides experience in analysis with computer software. Prerequisite: IEE 380

IEE 521 Urban Operations Research
Probabilistic modeling and analysis of transportation systems (car, bus, train) and emergency service systems (fire, police, and ambulance) using functions of random variables, geometric probability, queuing theory, location theory, network analysis and graph applications. Pre-requisites: Graduate Engineering student; Credit is allowed for only IEE 426, 498 (OR in Hospitals), 526 or 598 (OR in Hospitals)

IEE 526 Operations Research in Healthcare
Quantitative methods for modeling and analysis of healthcare systems to address operational and tactical decision-making problems. Topics include forecasting, scheduling, decision making, facility location and layout, staffing, quality control and supply chain management in hospitals and healthcare delivery facilities. Pre-requisites: Graduate Engineering student; Credit is allowed for only IEE 426, 498 (OR in Hospitals), 526 or 598 (OR in Hospitals)

IEE 530 Enterprise Modeling
Focuses on social, economic, and technical models of the enterprise with emphasis on the management of technological resources. Includes organization, econometric, financial, and large-scale mathematical models. Prerequisite: Graduate Standing.

IEE 533 Scheduling
Provides the basic theory of scheduling and introduction to the applications domain. Prerequisites: IEE 376 and 470

IEE 534 Supply Chain Modeling/Analysis
Techniques for modeling and analysis of supply chains. Inventory management, transportation/location models, value of information, channel alignment, risk pooling, contracts. Prerequisites: CSE 100 or 110, IEE 376, and 470.

IEE 535 Intro Intl Logistics Systems
Exploratory project-oriented course that addresses domestic and international logistics practices from a high-level descriptive perspective and an analytical model-based perspective. Prerequisite: IEE 376

IEE 541 Engineering Administration
Introduces quantitative and qualitative approaches to management functions, engineering administration, organizational analysis, decision making, and communication. Credit is allowed for only IEE 541 or 431. Prerequisite: Graduate Standing

IEE 545 Simulating Stochastic Systems
Analyzes stochastic systems using basic queuing networks and discrete event simulation. Basic network modeling, shared resources, routing, assembly logic. Credit is allowed for only IEE 545 or 475. Prerequisites: CSE 205 and IEE376; Co-requisites: IEE 470

IEE 547 Human Factors Engineering
Study of people at work; designing for human performance effectiveness and productivity. Considerations of human physiological and psychological factors. Credit is allowed for only IEE 547 or 437. Prerequisite: Graduate Standing

IEE 552 Strategic Technological Plng
Studies concepts of strategy, strategy formulation process, and strategic planning methodologies with emphasis on engineering design and manufacturing strategy, complemented with case studies. Presents and uses an analytical executive planning decision support system throughout course. Must be an Engineering graduate student AND a grade of C or better or co-enrolled in IEE 545, IEE 561, IEE 572 or IEE 574.

IEE 556 Introduction to Systems Engineering
Foundation course addressing the concepts needed for successful system planning, design and build process. Topics include successfully bringing large-scale systems to completion on schedule and on budget, modeling and cost estimating techniques, risk and variability. Graduate students are expected to have a background in and understanding of large-scale systems. Pre-requisite: Engineering graduate student; Credit is allowed for only IEE 456, 556 or 598 (Intro to Systems Engineering)

IEE 561 Production Systems
Understanding how factories operate, how performance is measured, and how operational changes impact performance metrics. Operational philosophies, increasing production efficiency through quantitative methods. Prerequisites: IEE 376 and IEE 470

IEE 563 Distributed Info Systems
Introduces concepts and technologies that form the core of distributed enterprise information systems. Topics include client-server architectures, distributed objects and paradigms, Internet, World Wide Web, distributed information sharing, network programming, and e-commerce and enterprise applications. Must be an Engineering MS//PHD student AND have completed IEE 505 with a grade C or better or be currently enrolled.

IEE 564 Planning Cmptr-Integrated Mfg
Theory and use of IDEF methodology in planning for flexible manufacturing, robotics, and real-time control. Simulation concepts applied to computer-integrated manufacturing planning. Must be an Engineering graduate student.

IEE 566 Simulation in Manufacturing
Uses simulation in computer-integrated manufacturing with an emphasis on modeling material handling systems. Programming, declarative, and intelligence-based simulation environments. Must be an Engineering graduate student and complete with a C or better IEE 475 or 545 or be currently enrolled.

IEE 567 Simulation System Analysis
Simulation modeling of processes involving discrete and continuous system components. Topics include random number generators, output analysis, variance reduction, and statistical issues related to simulation. Enroll requirements: Prerequisites: Must be an Engineering graduate student and have completed with a C or better IEE 475 or 545 or be currently
enrolled.

IEE 570 Advanced Quality Control
Process monitoring with control charts (Shewhart, cusum, EWMA), feedback adjustment and engineering process control, process capability, autocorrelation, selected topics from current literature. Prerequisite: IEE 380.

IEE 571 Quality Management
Total quality concepts, quality strategies, quality and competitive position, quality costs, vendor relations, the quality manual, and quality in the services. Prerequisite: Graduate Standing

IEE 572 Design Engineering Experiments
Analysis of variance and experimental design. Topics include strategy of experimentation, factorials, blocking and confounding, fractional factorials, response surfaces, nested and split-plot designs. Prerequisite: IEE 380.

IEE 573 Reliability Engineering
Nature of reliability, time to failure densities, series/parallel/standby systems, complex system reliability, Bayesian reliability, and sequential reliability tests. Prerequisite: IEE 380.

IEE 574 Appl Deterministic Oper Rsch
Develops advanced techniques in operations research for the solution of complex industrial systems problems. Goal programming, integer programming, heuristic methods, dynamic and nonlinear programming. Must be an Industrial Engineering MS//PhD student. Prerequisite: IEE 376 or 470.

IEE 575 Appl Stochastic Oper Rsch Mdls
Formulate and solve industrial systems problems with stochastic components using analytical techniques. Convolution, continuous-time Markov chains, queues with batching, priorities, balking, open/closed queuing networks. Enroll requirements: Prerequisites: IEE 376 and 470.

IEE 576 Analy Semiconductor Mfg Oper
Applies operations research and statistical methods to solve problems that involve semiconductor manufacturing operations. Prerequisites: IEE 376 and 470.

IEE 577 Adv Information System Oper
Industrial engineering knowledge and skills for information system operations, including aspects (security, quality of service, user interface, information modeling), problems, and solutions. Must be an Engineering graduate student and complete with a C or better IEE 505 or be currently enrolled.

IEE 578 Regression Analysis
Regression model building oriented toward engineers and physical scientists. Topics include linear regression, diagnostics, biased and robust fitting, nonlinear regression. Prerequisites: IEE 380.

IEE 579 Time Series Analy/forecasting
Forecasting time series by regression-based, exponential smoothing, and ARIMA model techniques; uses digital computer programs to augment the theory. Prerequisites: IEE 380.

IEE 580 Practicum
Structured practical experience in a professional program, supervised by a practitioner and/or faculty member with whom the student works closely. Must be an MS//PHD Industrial Engineering student.

IEE 581 Six Sigma Methodology
The six sigma process improvement strategy of define, measure, analyze, improve, and control (DMAIC). Integrates and deploys statistical methods and other six sigma problem solving via the DMAIC framework. Prerequisites: IEE 570, 572, 578. At least two of the courses must be completed before registering for this course and the third course must be taken concurrently.

IEE 582 Response Surfaces/Process Opt
Classical response surface analysis and designs including steepest ascent, canonical analysis, and multiple responses. Other topics include process robustness studies, robust design, and mixture experiments. Must be an Engineering MS//PHD student and have completed IEE 572 with a grade of C or better or be currently enrolled.

IEE 584 Internship
Structured practical experience following a contract or plan, supervised by faculty and practitioners. Must be an Engineering MS//PHD student.

IEE 585 Six Sigma Capstone.
The DMAIC (define, measure, analyze, improve, control) improvement strategy is applied in the formulation and execution of a six sigma project. Prerequisites: IEE 581.

IEE 590 Reading and Conference
Independent study in which a student meets regularly with a faculty member to discuss assignments. Course may include such assignments as intensive reading in a specialized area, writing a synthesis of literature on a specified topic, or writing a literature review of a topic.

IEE 591 Seminar
A small class emphasizing discussion, presentations by students, and written research papers.

IEE 592 Research
Independent study in which a student, under the supervision of a faculty member, conducts research that is expected to lead to a specific project such as a thesis or dissertation, report, or publication. Assignments might include data collection, experimental work, data analysis, or preparation of a manuscript.

IEE 593 Applied Project
Preparation of a supervised applied project that is a graduation requirement in some professional majors.

IEE 594 Conference and Workshop
Topical instruction, usually in compressed format, leading to academic credit. Often offered off campus to groups of professionals. Must be an Industrial Engineering MS//PHD student.

IEE 595 Continuing Registration
Used in situations where registration is necessary but where credit is not needed. Replaces arbitrary enrollment in reading and conference, research, thesis, dissertation, etc. Used by students when taking comprehensive examinations, defending theses or dissertations, or fulfilling the continuous enrollment requirement in doctoral programs. Credit is not awarded, and no grade is assigned.

IEE 598 Special Topics
Topical courses not offered in regular course rotation--e.g., new courses not in the catalog, courses by visiting faculty, courses on timely topics, highly specialized courses responding to unique student demand. Check with the instructor for prerequisites and/or co-requisites.

IEE 599 Thesis
Supervised research focused on preparation of thesis, including literature review, research, data collection and analysis, and writing.

IEE 605 Foundations of Information Systems Engineering
Introduces science and engineering technologies of information systems design and analysis with focus on industrial engineering applications. Topics include: design and analysis of computational algorithms; and data mining techniques for classification, clustering, feature extraction and data reduction problems. Pre-requisite: Industrial Engineering Graduate student; Credit is allowed for only IEE 598 (Found Info Syst Engr) or 605

IEE 620 Optimization I
First course of the Ph.D. level deterministic course series. This course covers foundations of optimization and linear programming. Prerequisites: MAT 272, 242, and IEE 376.

IEE 622 Optimization II
The course is a second graduate course of optimization. In this course, we introduce computational methods to solve optimization problem with integer variables efficiently as well as the mathematical theory. Pre-requisite: MAT 242 and IEE 376

IEE 640 Probability and Stochastic Processes
Presents fundamentals of probability and stochastic processes from a non-measure theoretic point-of-view to develop (a) basic model building and probabilistic reasoning skills, and (b) an understanding of important qualitative characteristics of some basic stochastic processes used to model dynamical systems with noise. Topics include a review of probability theory with particular attention to conditional probability and expectation; Markov chains; Renewal theory and the Poisson process. Considers applications in reliability, inventory theory, queuing. Pre-requisite: MAT 242, IEE 376 & 470

IEE 670 Mathematical Statistics
This course is an introduction to the field of mathematical statistics at a level intended for first-year Ph.D. students in Industrial Engineering. It builds a solid background in the principles, concepts and techniques of mathematical statistics. The class prepares students for advanced study and research in statistics, and is useful for understanding statistical data analysis techniques and developing statistical thinking. Prerequisites: IEE 380

IEE 672 Adv Topics-Experimental Design
Multilevel and mixed-level factorials and fractions, design optimality, incomplete blocks, unbalanced designs, random effects and variance components, analysis of covariance. Must be an Engineering MS//PHD student AND have completed with a C or better IEE 572 or be currently enrolled.

IEE 677 Regression/Genrlzd Linear Mod
Theory of linear models including least squares, maximum likelihood, likelihood-based inference. Generalized linear models including Poisson and logistic regression, generalized estimating equations. Must be an Engineering MS//PHD student and have completed with a C or better IEE 578 or be currently enrolled.

IEE 679 Time Series Analy/Control
Identification, estimation, diagnostic checking techniques for ARIMA models, transfer functions, multiple time series models for feedback and feed forward control schemes. Must be an Engineering MS//PHD student and have completed with a C or better IEE 579 or be currently enrolled.

IEE 684 Internship
Structured practical experience following a contract or plan, supervised by faculty and practitioners.

IEE 691 Seminar
A small class emphasizing discussion, presentations by students, and written research papers.

IEE 700 Research Methods
Course on research methods in a specific discipline. Must be an Engineering MS//PHD student.

IEE 784 Internship
Structured practical experience following a contract or plan, supervised by faculty and practitioners.

IEE 790 Reading and Conference
Independent study in which a student meets regularly with a faculty member to discuss assignments. Course may include such assignments as intensive reading in a specialized area, writing a synthesis of literature on a specified topic, or writing a literature review of a topic.

IEE 792 Research
Independent study in which a student, under the supervision of a faculty member, conducts research that is expected to lead to a specific project such as a dissertation, report, or publication. Assignments might include data collection, experimental work, data analysis, or preparation of a manuscript.

IEE 795 Continuing Registration
Used in situations where registration is necessary but where credit is not needed. Replaces arbitrary enrollment in reading and conference, research, thesis, dissertation, etc. Used by students when taking comprehensive examinations, defending theses or dissertations, or fulfilling the continuous enrollment requirement in doctoral programs. Credit is not awarded, and no grade is assigned.

IEE 799 Dissertation
Supervised research focused on preparation of dissertation, including literature review, research, data collection and analysis, and writing. Grading method: Pass/Fail with Z Option

Industrial Engineering Faculty

Mary R. Anderson-Rowland, Ph.D.
University of Iowa (IS)
Statistics and probability for quality control, academic scholarship programs for all engineering students with an emphasis on women and underrepresented minority students.

Ronald G. Askin, Ph.D.
Georgia Institute of Technology (OR, PSL, IS)
Design and operation of discrete manufacturing systems, decision analysis, applied operations research, facilities planning, industrial statistics and applied optimization.

Linda Chattin, Ph.D.
State University of New York, Buffalo (IS, OR)
Discrete optimization, stochastic processes and probabilistic modeling, and emergency service location.

John W. Fowler, Ph.D.
Texas A & M University (OR, PSL)
Deterministic scheduling, discrete event simulation methodology, semiconductor manufacturing systems analysis and applied operations research.

Esma S. Gel, Ph.D.
Northwestern University (OR, PSL)
Applied probability, stochastic processes, queuing theory, stochastic modeling and control of manufacturing systems.

Jing Li, Ph.D.
University of Michigan (IS, PSL)
Applied statistics, process control, data mining, causal modeling and inference.

Pitu B. Mirchandani, Sc. D.
Massachusetts Institute of Technology (OR, PSL)
Stochastic dynamic networks, location theory, real-time decision making under uncertainty and competition, and intelligent transportation systems.

Douglas C. Montgomery, Ph.D.
Virginia Polytechnic Institute and State University (IS, PSL)
Statistical design of experiments, optimization and response surface methodology, empirical stochastic modeling and industrial statistics.

Rong Pan, Ph.D.
Pennsylvania State University (IS, PSL)
Industrial statistics, reliability analysis and time series modeling.

George C. Runger, Ph.D.
University of Minnesota (IS, IMS)
Statistical learning, process control, and data mining for massive, multivariate data sets with applications in numerous disciplines.

Soroush Saghafian, Ph.D.
University of Michigan (OR, PSL)
Healthcare operations, control of flexible queuing systems, and supply chain and operations management.

Dan L. Shunk, Ph.D.
Purdue University (IMS, PSL)
Agile, enterprise and CIM systems, group technology, planning systems, economics of computer-integrated manufacturing (CIM), strategy and strategic role of technology.

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Quality engineering, industrial statistics, engineering management

Wandaliz Torrez-Garcia, Ph.D.
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Bioinformatics, Industrial statistics.

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Logistics, automated quality systems, manufacturing systems and applied operations research.

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University of Iowa (IMS, PSL)
Information systems, supply chain management, multi-agent systems, data mining, Petri nets, Kalman filtering.

Nong Ye, Ph.D.
Purdue University (IMS)
Information and systems assurance, data mining and modeling, quality optimization and control systems operations.

Muhong Zhang, Ph.D.
University of California, Berkeley (OR)
Integer programming, robust optimization, computational, optimization and network optimization