

**Industrial Engineering**  
**Ph.D. Graduate Handbook**  
**2021 - 2022**



**MANUAL OF THE PH.D. DEGREE IN  
INDUSTRIAL ENGINEERING**

**ARIZONA STATE UNIVERSITY**

**2021 - 2022**

IE graduate degrees please contact:

Office of Graduate Programs  
Of Industrial Engineering  
Ira A. Fulton School of Engineering  
Arizona State University  
PO Box 878809  
Tempe, AZ 85287-8809  
PHONE: (480) 965-3199

IE on the web: <http://SCAI.engineering.asu.edu/forstudent/graduate/industrial-engineering/>

E-mail address: [cidse.advising@asu.edu](mailto:cidse.advising@asu.edu)

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## **I. Introduction to the Industrial Engineering Program**

The Industrial Engineering (IE) program of the Ira A. Fulton School of Engineering at Arizona State University (ASU) offers an advanced academic program leading to the Doctor of Philosophy (Ph.D.) degree. The program requires core and elective coursework, Qualifying and Comprehensive Exams, a written dissertation, and an oral defense of the dissertation. The Ph.D. degree is offered to exceptional students who have completed, with distinction, a 'Bachelor's or 'Master's degree in engineering, or a closely related field.

Here at ASU's School of Computing and Augmented Intelligence (SCAI), formerly the School of Computing, Informatics, and Decision Systems Engineering (CIDSE), we envision a society where secure, accurate, and current information is ubiquitously available and data is seamlessly collected, managed, and converted into information that entertains individuals, empowers businesses, and guides the decisions of both in their daily affairs.

We envision our school as a community recognized by its colleagues internationally as a leader in envisioning and enabling the information-driven society and by students as a preferred location for acquiring the knowledge and skills necessary to contribute to this vision.

We envision a community of scholars cooperatively engaged in transdisciplinary research addressing the grand challenges of modern society and supporting the intellectual growth of students and colleagues.

Our mission is to benefit society through excellence in education, use-inspired research from basic to translational, and leadership in service to the profession and community. We seek to provide a supportive environment that promotes creativity, diversity, multidisciplinary teaming, scholarship, and ethical behavior in order to advance knowledge and practice in computing, information and decision technologies to enhance society.

ASU prohibits all forms of discrimination, harassment and retaliation. To view ASU's policy please see <https://www.asu.edu/aad/manuals/acd/acd401.html>.

Title IX protects individuals from discrimination based on sex in any educational program or activity operated by recipients of federal financial assistance. As required by Title IX, ASU does not discriminate on the basis of sex in the education programs or activities that we operate, including in admission and employment. Inquiries concerning the application of Title IX may be referred to the Title IX Coordinator or to the U.S. Department of Education, Assistant Secretary, or both. Contact [titleixcoordinator@asu.edu](mailto:titleixcoordinator@asu.edu) or 480-965-0696 for more information. Office located at 1120 S. Cady Mall, INTDSB 284. For information on making a report please go to [www.asu.edu/reportit/](http://www.asu.edu/reportit/).

## 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 College and the Industrial Engineering program requirements. In most of the cases, the differences are because the IE Program has established higher standards than those set forth by the Graduate College. Thus, 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 e-mail, and will be posted on the SCAI website.

## III. Student responsibility and resources

All students are expected to become familiar with university and program policies and procedures and abide by the terms set forth. Information will be e-mailed and will be available online. Most importantly, you should visit the following websites:

- The Graduate College – <http://graduate.asu.edu> .
- Graduate College Policies and Procedures – <https://graduate.asu.edu/policies-procedures>
- The Industrial Engineering Program – <http://SCAI.engineering.asu.edu/forstudent/graduate/industrial-engineering/>
  - The International Student and Scholars Center– <https://issc.asu.edu/>, if applicable.
- The Ira A. Fulton School of Engineering – <http://engineering.asu.edu>

### Wellness Resources

We believe graduate education provides an opportunity to grow in our knowledge and expertise, and during our studies, we may face challenges and hardships that can affect our wellbeing. The Graduate College and the ASU Graduate Student Association have put together resources and best practices guides to help your educational journey. Should you need additional guidance and support, we encourage you to contact a graduate advisor at the SCAI Graduate Advising Office.

- [Graduate Wellness Resources](#) – a one-page guide to Financial, Social, Emotional, and Physical Health and Wellness Resources for ASU Graduate Students was developed by the GPSA .
- [10 Best Practices in Graduate Student Wellbeing](#) – proven ways to help graduate students better care for themselves under the increasing demands of graduate school

## 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 a list of the faculty names, areas of expertise, and research interest at the end of this handbook.

## V. **Admission and eligibility to the doctoral degree program**

The Industrial Engineering doctoral degree requires a background in engineering, math, statistics, physical science, or a closely related field. However, in some cases, students with non-traditional educational backgrounds will be considered for admission. These students may be required to take fundamental courses to prepare them for the program coursework better. A student is encouraged to contact the School of Computing, Informatics, and Decision Systems Engineering (SCAI), Advising Center to obtain advice on their educational pursuits.

**Eligibility** - Before applying to the IE doctoral program, students are required to have completed 3 semesters or 12 credit hours of Calculus, including Multivariate Calculus.

**Application** - All students are required to submit a complete application with the Office of Graduate Admission <https://students.asu.edu/graduate> and pay the required fee to have their application properly processed.

### **Application deadlines - December 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 an official **general** Graduate Record Examination (GRE) scores directly to the Office of Graduate Admission. Students with an exceptional background who have graduated with a 'bachelor's degree from ASU may petition to request a GRE waiver by contacting the SCAI Advising Office. The average GRE scores for students admitted into the Ph.D. program have typically been around 151 Verbal, 163 Quantitative, and 4.0 Analytical. However, admission decisions are made based on the entire application packet. We do not require specific subject GRE scores. The ASU Institution code is 4007. If department code is required, use 000 for GRE.

**English Proficiency** - 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, or Pearson (PTE). Industrial Engineering Program uses average scores of 575 (paper-based) or 90 (internet-based) for TOEFL, 7.0 for IELTS, or 115 for Duolingo, and 65 for PTE for admission. **Please note that your application will not be processed until the university receives official scores, which are valid two years from the start date of the degree program.** Exemption from the English Proficiency requirement can be met by visiting the Graduate Admission site under English Proficiency. Please address all English Proficiency questions to the Office of Graduate Admission <https://admission.asu.edu/international/graduate/english-proficiency>. The ASU institution code is 4007 if a department code is required, use: 99 for TOEFL.

**Personal statement** - The application must include a personal statement. The statement should: 1) explain professional goals and reasons for desiring to enroll in the doctorate program; 2) describe any research experiences; 3) indicate personal research interests; and 4) identify two or three ASU IE faculty with matching research interests.

**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 Admission 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** - Students applying directly from an undergraduate program must have a minimum cumulative GPA of 3.5 in the last 60 credit hours of the undergraduate degree and have been involved in some form of research at the undergraduate level. Students who are applying following a 'Master's degree must have a minimum GPA of 3.5 for the last degree awarded.

**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. Please note that deficiencies are not intended solely as pre-requisites for graduate coursework; they also satisfy the breadth requirement for all graduates of IE.

Below is a list of pre-requisites along with the associated ASU course numbers:

- CSE 110 – Principles of Programming
- CSE 205 – Object-oriented Programming and Data Structure
- MAT 242 – Elementary Linear Algebra
- IEE 380 – Probability and Statistics for Engineering Problem Solving
- IEE 376 –Operations Research Deterministic Techniques/Applications
- IEE 470 – Stochastic Operations Research

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

**Option 1: Waiver Process:** Students wishing to have their course syllabi examined as evidence that deficiencies have been satisfied must submit a petition. The request will need to be submitted using the [Petition for Reevaluation of Deficiency Course](#) form along with supporting documents such as a syllabus, catalog description, and university transcripts (including the grade scale), to prove that you have met the requirements. Be advised that the documents you uploaded during the admission application have been

evaluated, so a reevaluation petition should only be submitted if you have **new** information to provide. Once the petition has been reviewed, it is final. There will be no future petition or consideration request. If, after evaluation, the petition is not approved, the student may choose to take the deficiency test-out examination.

**Option 2: Deficiency test-out exam:** Prior to fall and spring semesters, an online course proficiency examination (CPE) is provided to allow students entering with deficiencies (listed in the admission letter) to take a test to establish whether they possess basic knowledge of the course material sufficient to have an assigned deficiency waived. The cost for each subject examination is \$59, payable at the time of registration. 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. There are no CPE exams for CSE 110, 205, and MAT 242.

**Option 3: Enrolling in the course:** Students who could not clear their assigned deficiency through the waiver process or deficiency test-out exam are required to enroll and pass the course(s) in their first year.

**Notice of Admission** - IE submits its recommendation of admission to the Office of Graduate Admission, and the Office of Graduate Admission notifies the final notice of admission decision in writing. You may check your application status on MyASU (my.asu.edu).

**Pre-admission credits and transfer credit** – Please refer to the Graduate College policies and procedures. Approved transfer credit cannot count towards meeting the core requirement unless the credit was earned at ASU.

## VI. Doctoral degree requirements

Degree requirements for the Ph.D. include a minimum of 85 semester hours beyond the bachelor's degree and deficiency courses. A maximum of 30 credit hours taken during the Master's degree can be applied to a Ph.D. degree if coursework is approved as applicable to the doctoral degree.

The Ph.D. is comprised of five milestones, which all students are required to pass successfully before graduation:

- a. Completion of the core coursework,
- b. Passing the Qualifying Examination on the core coursework,
- c. Filing an approved Plan of Study,
- d. Passing the Comprehensive Examination and approval of the dissertation prospectus to advance to candidacy,
- e. Successful oral defense of an approved written dissertation.

Assigned deficiency courses must be completed by the end of the 12<sup>th</sup> semester hour. """"A ""B"" or better must be achieved in each deficiency course. A grade of ""B"" or better in a course that follows a pre-requisite deficiency course does not waive this requirement.

**a. Core courses:** All incoming students are required to complete the five core courses, of which at least four have to be completed in their first year for full-time students or within two years for part-time students.

The core courses are:

- IEE 605 – Foundations of Information Systems (3)
- IEE 620 - Optimization I \* (3)
- IEE 622 - Optimization II (3)
- IEE 640 - Stochastic Processes\* (3)
- IEE 670 - Mathematical Statistics\* (3)

**b. Qualifying Examination\*:** Students will be tested for the Qualifying Exam on IEE 620, IEE 640 and IEE 670. Students should take the Qualifying Exam immediately after they are eligible. Each student must sit for the qualifying exam on the 3 core courses and pass them prior to progressing in his/her academic degree. Students who fail are allowed only one re-examination on the subject(s) they fail the first time, which should be taken at the next scheduled examination date. A student must have a cumulative and graduate GPA of 3.0 or higher, have obtained C or better for every core course, and have completed all assigned deficiency courses to sit for the qualifying exam.

**Note:** Students who are interested in obtaining a Master in Passing Degree through the Qualifying exam option see Section VI.a.

**c. Formulation of the Plan of Study:** After completing the core courses and passing the Qualifying Examination, students will be required to develop and submit a Plan of Study (iPOS) through MyASU. A minimum of 85 credit hours is required in the Plan of Study. The degree is comprised of one major area (minimum of 18 credit hours) and two minors (minimum of 9 credit hours each). The Plan of Study must have the following required minimum components:

1. Five core courses (15 credit hours) (see previous *Core courses* for details)
2. Area & minor emphases coursework
  - Coursework of 42 credit hours beyond the core, of which at most 30 credit hours (subject to approval) from the 'Master's degree are applied. The core courses can be applied to the major area and the two minors. Similarly, the approved 30 credit hours from the 'Master's degree can be applied towards the major area and the two minors.
3. Academic preparation
  - IEE 594 Seminar and Conference (1)
  - IEE 700 Research Methods (1) – Take this course in the Spring semester when it is offer before planning for the Comprehensive Exam/Prospectus.
  - IEE 790 Independent Study or IEE 584 Internship or an additional 1 hour of IEE 594 (1).
  - IEE 784 Teaching Internship (1)
4. Research & dissertation
  - IEE 792 Research or graduate coursework (12)
  - IEE 799 Dissertation (12)

**A maximum of six credit hours of 400 level coursework may be used on an approved iPOS (400 level courses taken for a grade of Pass/Fail cannot be included on an iPOS). Students must get approval from the Program Chair before enrolling and completing a 400 level coursework, except for the course that is a deficiency requirement. Courses with grades of "D" (1.00) and "E" (0.00) cannot be included on an IPOS.**

**d. Dissertation Supervisory Committee:** The role of the supervisory Committee is to provide guidance and direction for the 'student's educational and research plan. As such, the Committee must have the necessary expertise to guide and evaluate research in the proposed dissertation area. A minimum of four committee members is required, including the committee chair or two co-chairs. The Chair and Co-chairs must be selected from the approved program list of graduate IE faculty by the Graduate College. On case-by-case, a onetime approval can be given for an individual to serve as the co-chair for a student's dissertation. The Committee must be made up of at least three members who are in the IE graduate faculty. The supervisory Committee must be approved by the IE Program Chair and by the Dean of the Graduate College before taking the Comprehensive Examination.

The first step in forming a Supervisory Committee is securing a Chair of the Committee. It is the responsibility of the student that an IPOS with Committee Chair is filed no later than the semester after completing the 24th credit or second semester after taking the Qualifying Examination. It is also the joint responsibility of the student and his/her Committee Chair to file an iPOS identifying the overall committee composition no later than the semester after completing the 40th credit of the preliminary iPOS.

**e. Comprehensive Examination:** The Comprehensive Examination can be scheduled after passing the qualifying exam. The comprehensive exam must be taken no later than the semester following the semester in which the 57<sup>th</sup> credit of iPOS coursework are completed. The comprehensive examination and the dissertation prospectus are separate processes, both of which culminate with the oral comprehensive examination. The committee chair will advise the student of the expectations of the exam.

The student first makes arrangements with the advisory committee chair to schedule five weeks for the examination. Care must be taken to ensure that the entire examination will fall into one of the two regular semesters. The exam consists of two parts: a) a written exam; and b) an oral defense on both the Comprehensive Exam and the Dissertation Prospectus. While separate, the two oral portions of the exam may be held at the same time. **The student is required to bring a Report of Doctoral Comprehensive Examination and Approval of the Ph.D. Dissertation Prospectus forms available on the SCAI [website](#) to the oral examination, and after completion of the examination, the Chairperson should submit the form to the Graduate Academic Advisor.**

The five weeks will be spent as follows:

1. The student will submit a research proposal to the advisory committee. Guidelines for proposals are presented in the Dissertation Prospectus below.
2. The members of the committee will submit a written question(s) to the Dissertation

Chair of the committee one week after submission of the research proposal. These questions should relate to the research area suggested by the student or to the coursework taken by the student.

3. The student will have 17 consecutive calendar days to develop written responses to the questions. The candidate should submit one complete, bound set of answers to all questions to each committee member.
4. The general knowledge oral portion of the examination will be held within two weeks of submission of the written responses. This examination normally lasts about two hours and will be primarily related to the research area, the 'student's written responses, and the dissertation prospectus. Appropriate related fundamental concepts may also be covered.
5. The final Pass/Fail is determined based on the combined responses to written and oral examination questions. A majority vote by the committee and a passing vote by the committee chair are required to pass.
6. Passing the prospectus examination makes the student a candidate for the Ph.D. degree. The Graduate College will inform the student and IE Office when candidacy is granted.

### **Retaking the Exam**

Failure of the comprehensive examinations and the dissertation prospectus is considered final unless the supervisory committee the Graduate Program Chair, and the Dean of the Graduate College approves a re-examination. At any junction in the examination portion a student fails, he/she is not allowed to proceed to the next examination portion until a re-examination of the failed portion has been passed. The will have to petition and obtaining approval by the Graduate Program Chair and the Dean of the Graduate College. A re-examination may be administered no earlier than three months and no later than one year from the date of the original examination. Only one re-examination is permitted.

The **Dissertation Prospectus** is a research proposal that precedes the dissertation. It is a document that introduces the doctoral 'student's proposed original contribution to the field of industrial engineering that will be created through the doctoral research and writing of the dissertation. The prospectus should raise an important issue in the field and discuss the 'issue's contribution to the discipline. The doctoral student should work with their advisor or co-advisors to prepare the prospectus. The committee members review the prospectus for originality and contribution. Following that, oral delivery and a committee review of the Dissertation Prospectus should be scheduled. This oral prospectus defense is considered to be a part of the Comprehensive Exam and may be held in conjunction with the general knowledge defense.

While the format of the proposal is up to the committee chair, the written proposal document typically contains:

1. A title page with the author's name, committee members' names, institution, and date.
2. A table of contents.
3. An introduction explaining the nature of the research.
4. A clear statement of the research problem.

5. A thorough review of all relevant literature.
6. An argument that the problem is of sufficient relevance and importance to study.
7. A description of the proposed methodology and argument for its acceptability.
8. A statement of the expected contributions of the research.
9. A plan/schedule for completion of the research.
10. A complete bibliography following an accepted style.

The final version of the proposal is a binding agreement between the student and the Committee and will be enforced by the IE Program. Satisfactory completion of the research, as outlined in the proposal, will result in an approved dissertation. Following the approval of the written dissertation, the student must schedule and pass a final oral defense.

**f. Dissertation Defense and 10-Day Rule:** Defense of a dissertation comprises submission of an approved dissertation followed by its successful oral defense. Students are required to submit a paper based on the dissertation research to an IE-related refereed journal before the final examination. They are strongly encouraged to present a conference paper(s) on their work during the research. These publications are normally jointly written with the advisor and other appropriate faculty. Successful oral defense of the dissertation fulfills the IEE 799 requirement.

#### **Steps to Preparing for Your Defense**

##### Before defense:

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

##### 10 days before the defense:

These steps are required to be completed before 10 working days from the date of the oral defense.

1. Reserve a room with the SCAI front desk (Brickyard 5<sup>th</sup> floor). Due to COVID-19, the defense may be held through Zoom.
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 SCAI front desk.
3. Schedule your defense on MyASU with the Graduate College.

##### 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.

##### After the defense:

1. Your committee will discuss the results of the exam with you and may have additional comments for you. In the end, the committee will make a

recommendation: Pass, Pass with minor revisions, Pass with major revisions, or Fail.

2. Failing the dissertation defense is final.
3. 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.
4. Follow the steps on MyASU on uploading your final dissertation through the Graduate College and ProQuest.

## **VII. General Information**

### **a. Master's in Passing**

After completion of 30 credit hours in the Ph.D. program and successfully passing the Qualifying Exam, students have the opportunity to request a 'Master's in Passing. For students to be awarded the Masters in Passing, the 30 completed credit hours must include 15 credit hours of core coursework. The Graduate Academic Advisor will help eligible students file a 'Master's in Passing Plan of Study (MIP/IPOS). Students must then file for graduation, which includes a fee.

Note- Similarly to the regular, I.E. M.S. Degree, the 'Master's in Passing has a **culminating event** requirement, which consists of a written project. Due to university rules, the project can be completed during Fall and Spring semester or be enrolled in summer to count towards degree requirement. PhD students interested and eligible to obtain the 'Master's in Passing degree have three options to satisfy their culminating event requirements: (1) Register for one graduate-level credit hour during the semester that they take the Qualifying Examination and use the Qualifying Examination as the culminating event; (2) Participate in the M.S. Project offered in fall and spring semesters each academic year; or (3) Use the written portion of their Ph.D. Comprehensive Examination when scheduled in a spring or fall semester.

Please communicate in advance of your intent to the Graduate Advising Team.

### **b. Research standards for publication of dissertation**

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 1,500 hours of thoughtful work for a dissertation (Ph.D.). The research should follow the 'scientific 'method' and thus be both objective and reproducible. The dissertation 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 Graduate College format guidelines. For more information on format guidelines, please visit the Graduate College web site [https://graduate.asu.edu/completing-your-degree#tabs-0-content\\_main-5](https://graduate.asu.edu/completing-your-degree#tabs-0-content_main-5)

### **c. Financial assistance and/or fellowships**

The Industrial Engineering 'Program's goal is to provide support to all incoming Ph.D. students. According to the 'student's academic performance and past academic research, funding offers will be extended to individual students with the highest academic

achievements. We encourage students to highlight their past academic achievements in their statement and their resume.

**d. Continuous Enrollment and Leave of Absence Policies**

Once admitted to a graduate degree program or graduate certificate program, students must be registered for a minimum of one credit hour during all phases of their graduate education, including the terms in which they are admitted and graduate. This includes periods when students are engaged in research, conducting a doctoral prospectus, working on or defending theses or dissertations, taking comprehensive examinations, taking Graduate Foreign Language Examinations or in any other way utilizing university resources, facilities or faculty time.

Registration for every fall semester and spring semester is required. Summer registration is required for students taking examinations, completing culminating experiences, conducting a doctoral prospectus, defending theses or dissertations or graduating from the degree program.

To maintain continuous enrollment, the credit hour(s) must:

- Appear on the student's Interactive Plan of Study, OR
- Be research (, 792), thesis (599), dissertation (799), or continuing registration (595, 695, 795), OR
- Be a graduate-level course.

Grades of "W" and/or "X" are not considered valid registration for continuous enrollment purposes. "W" grades are received when students officially withdraw from a course after the drop/add period. "X" grades are received for audit courses. Additionally, students completing work for a course in which they received a grade of "I" must maintain continuous enrollment as defined previously. Graduate students have one year to complete work for an incomplete grade; if the work is not complete and the grade changed within one year, the "I" grade becomes permanent and will remain on the students' transcripts. Additional information regarding incomplete grades can be found at [asu.edu/aad/manuals/ssm/ssm203-09.html](http://asu.edu/aad/manuals/ssm/ssm203-09.html).

**Leave of Absence**

Students planning to discontinue enrollment for a semester or more must request approval for a leave of absence. A student may petition the Graduate College for a leave of absence for a maximum of two semesters during their entire program. The Graduate College dean must approve a petition for a leave of absence, endorsed by the members of the 'student's supervisory committee and the head of the academic unit. **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 Graduate College 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**

Doctoral students must complete all program requirements **within a 10 year period**. The ten-year period starts with the semester and year of admission to the doctoral program. Graduate courses are taken before 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 (previously awarded 'master's degrees used on the Plan of Study are exempt).

Any exceptions must be approved by the supervisory committee, and the Graduate College dean and ordinarily involves repeating the comprehensive examinations. The Graduate College may withdraw students who are unable to complete all degree requirements and graduate within the allowed maximum time limits.

**f. Registration requirements for research assistants (RA) and teaching assistants (TA)**

Students awarded an assistantship within the Ira A. Fulton School of Engineering are required to be registered for 12 credit hours. Audit credit hours do not count towards the 12 credit hours.

Students who obtain an assistantship outside the Ira A. Fulton School of Engineering are required to be enrolled a minimum of 6 credit hours. Enrollment in continuing registration (IEE 795) does count towards the 6-hour requirement.

Students with TA/RA .50 FTE appointments (i.e., 20 hours per week), who are appointed within the first 8 weeks of a semester during the academic year, receive an award covering tuition for the semester. Students with TA/RA .50 FTE appointments during the summer session(s) receive an award covering tuition.

Students with TA/RA .25–.49 FTE appointments (i.e., 10–19 hours per week), who are appointed within the first 8 weeks of a semester during the academic year, receive an award covering 100% of the nonresident portion of tuition and an award covering 50% of the remaining tuition for the semester. Students with TA/RA .25–.49 FTE appointments during the summer session(s) receive an award covering 100% of the nonresident portion of tuition and an award covering 50% of the remaining tuition.

The university provides an award covering the premium for individual health insurance for teaching and research assistants/associates who meet the minimum eligibility requirements during the duration of their appointment (coverage periods are August 16–January 15 and January 16–August 15). These are:

- appointment at 50% time (20 hours per week)

- hired as a TA or RA no later than the end of the eighth week of classes of the semester

There are four ways a student can fulfill the English language requirement. Any of the following will fulfill the language requirement:

1. Take and pass the SPEAK test with a score of 55 or higher. Only SPEAK scores from Global Launch are allowed.
2. Take the iBT (Internet-based TOEFL) test and receive a score of 26 or higher on the oral portion of the test.
3. Take the IELTS test and receive a score of 8 or higher on the speaking portion of the test.
4. Complete the ITA Teacher Training Course with a score of 'certified.'

**g. Satisfactory Progress, Academic Probation, Progress probation, and Withdrawal from the IE Program**

At the end of the student's first completed semester and every semester thereafter, the school will conduct an audit to determine if the student is maintaining the required minimum satisfactory progress, including progress on academic (GPAs and deficiencies) and probationary issues. Any student that is not in compliance with the satisfactory academic/ progress requirements is notified that she/he is either

- on academic probation and is given the next 9 credit hours or two semesters (fall and spring) to bring the GPA up to the proper level or
- on continued progress probation and is required to meet the conditions outlined in the continued probation letter.

Failure to properly remediate the GPA or the conditions outlined in the letter within the time frame will result in the school recommending that the student be dismissed from the program.

**Note:** Fully admitted students who take optional summer courses are placed on probation after the summer term if the earned grade(s) causes their GPA to fall below the satisfactory progress GPA minimum.

If applicable, the above-noted audit will also review each student's progress towards removing enrollment deficiency courses and/or any other degree requirement milestone(s). Failure to satisfactorily complete all deficiency course(s) and/or required milestones by the stipulated deadline may result in a recommendation for dismissal to the Graduate College.

Each semester, the Industrial Engineering Program reviews 'students' files for satisfactory progress towards completion of the degree. All students who do not meet on one of the four categories are placed on probation or withdrawn from the program:

- 1) Satisfactory progress;
- 2) Academic Probation;
- 3) Progress probation;

4) Withdrawal from the IE Program.

1. **Satisfactory progress** means that a student does not have any academic and progress probationary issues. In addition to the probationary rules, satisfactory progress includes each semester communication with the 'student's Committee Chair regarding his/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 iPOS courses;
  - Cumulative GPA (post-baccalaureate) below 3.0;
  - 500-level and above (graduate) GPA below 3.0;
  - The deficiency course grade is 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 completing Ph.D. program admission deficiencies, as specified in your admission letter.
  - Lack of progress toward completing at least four of the five core courses within the first year for full-time students or two years for part-time students (see Section VI.a).
  - Failure to take and pass the Ph.D. Qualifying Examination in compliance with the timeline and requirements stated in Section VI.b.
  - Failure to file an iPOS with Committee Chair no later than the semester immediately after passing the Qualifying Examination (see Section VI. d).
  - Failure to take and pass the Ph.D. Comprehensive Exam in compliance with the timeline and requirements stated in Section VI.e.
  - Failure to maintain regular contact with the Committee Chair and make satisfactory progress toward completion of the dissertation.
4. A student is recommended for **withdrawal from the IE Program** if the student 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 5 calendar days from the date of the letter to appeal the decision. The IE Graduate Program Committee (GPC) will review the case and will make the necessary recommendation. The Graduate Program Chair, on behalf of the GPC, 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 GPC recommends that the appeal is not granted in favor of the student, the Graduate Program Chair, on behalf of the GPC, 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 Graduate College to withdraw

the student from the IE Program. Please refer the Graduate College on policies and procedures or contact the graduate advisor in the SCAI Advising Center.

#### **h. Academic Integrity**

The highest standards of academic integrity are expected of all graduate students, both in 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 schools 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. Also, 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 Student Life, or at <http://graduate.asu.edu/beintheknow> .

#### **i. IEE 584 Internship**

IEE 584 Internship Curricular Practical Training (CPT) is an academic experience usually obtained at off-campus work settings, allowing the student to apply knowledge and skills gained in various classes. It is intended as a unique, hands-on learning experience to provide students with several valuable skills that they can use upon graduation from their graduate degree programs. Accordingly, it is not available to full-time or part-time workers regularly employed by the company where the internship is proposed.

The CPT is available to both domestic and international students. However, international students must work with the International Students and Scholars Center (ISSC) and submit additional documentation to obtain work authorization. Furthermore, students are strongly encouraged to include a maximum of three one-credit hours of CPT course IEE 584 (1 credit hour) as an integral part of their Program of Study, reflected by their approved iPOS. These credits are not part of the 85 mandatory credits (including the one credit required academic preparation option of IEE 790, 594 or 584). Addition of the CPT course(s) should be done at the initial submission of the 'student's iPOS. The Internship course cannot be added to an approved iPOS once all coursework has been completed. Exceptions may be made if the internship is relevant to dissertation research.

The IE Program Chair will determine the need for a CPT internship in such cases in consultation with the Graduate Academic Advisor. Note that approval of an iPOS with the IEE 584 course confirms that the internship is an integral part of the degree requirements as planned by the student. An additional internship that is not part of the 85 credit hours can be removed from the iPOS. Note: Only internship courses can be removed from the iPOS. Courses that are approved as part of the overall degree program in the iPOS can only be substituted with another approved coursework

**Eligibility:** In order to be eligible for an internship, a student must not be in academic probation (refer to section VI.g.2 in the handbook).

Who can participate:

All students (domestic and international) can participate in an out of state or an in-state internship, full time or part-time in the summer semester if ALL of their GPA's (graduate, IPOS and CUM GPA are at least a 3.0.

Students with all GPAs between 3.0-3.24 may participate in an in-state internship part time only in the fall and spring semesters.

Students with all GPA's 3.25 or higher may participate in an out of state or in-state internship, part time or full time in the fall and spring semesters.

During the regular Fall and Spring semesters, international graduate students in F-1 status must register for a minimum of nine (9) credit hours to maintain full-time status.

Required documents and forms for the internship proposal must be submitted to the SCAI Advising Office at least two weeks before the beginning of the semester in which the internship is planned. Students will not be able to request late-add registration of the IEE 584 Internship credit to their class schedule after the drop/add deadline of each semester. 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 the Graduate Program Director before registering for IEE 584. In order register for the IEE 584 - Internship, a student must have a cumulative, graduate and iPOS GPA of 3.00 or above and not have an academic integrity violation in a course for two full semesters (summer semesters not included) from the initial reporting of the incident. A final Plan of Study must be filed with the Graduate College 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.

International students need to be aware of immigration policies and regulations, which may jeopardize their academic status. Hence, it is strongly recommended for international students to consult with the International Students and Scholars Center (ISSC).

All students (domestic and international) may take part in an Out-Of-State internship in the summer semester. The eligibility requirements for CPT internships remain the same as mentioned.

During the regular fall and spring semesters, international graduate students in F-1 status must register for a minimum of nine (9) credit hours to maintain full-time status and be enrolled in a minimum six (6) credit hours of in-person, on-campus coursework at the ASU Tempe campus. A maximum of three (3) credit hours of online course is permitted. The IEE 580 Practicum course will not count as satisfying the 'student's "physical presence" at ASU. Students will not be able to take part in internships outside the Phoenix metropolitan

area. In some cases, students may be approved to do an internship in Tucson or other nearby locations to Phoenix, as long as the student can prove they can physically attend their courses on campus.

Required documents and forms for the internship proposal must be submitted to the SCAI Advising Office at least two weeks before the beginning of the semester in which the internship is planned. Students will not be able to request late-add registration of the IEE 584 Internship credit to their class schedule after the drop/add deadline of each semester.

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 the Graduate Program Chair before registering for IEE 584. To register for the IEE 584 - Internship, a student must not be in academic probation (refer to section VI.g.2 in the handbook). A final Plan of Study must be filed with the Graduate College 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.

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

It is unethical for students to continue to seek or consider other employment opportunities once an offer has been accepted. SCAI expects students to honor an acceptance and withdraw from all employment seeking activities. Students who accept an offer from an organization and later renege/decline the offer will be prohibited from further requesting future CPT pending a meeting with the Assistant Director.

**A five-page final report is required** at the end of the internship 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. Refer to the [SCAI website](#) for guidelines to prepare the final report.

**j. IEE 790 Independent Study**

Independent study is available for Ph.D. students. The student cannot combine IEE 790, 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, which 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.

### **L. Instructional Concerns and Course-Related Complaints**

Being part of a large university creates opportunities to learn from a diverse instructor population with different teaching styles and modalities for delivering course content. Courses are offered by a diverse set of faculty, including those who are research-intensive, those whose primary responsibility is teaching, and part-time faculty who are working in the field. Based on enrollment or modality of offering, faculty may also be supported by graduate student teaching assistants and graders. This diverse higher education delivery platform may differ significantly from the high school experience, and while it provides an opportunity to expand the student's ability to learn and develop problem solving skills, concerns and conflicts with requirements and instructors may occasionally arise. SCAI students with instructional concerns should review and adhere to the following guidelines for attempting to resolve their issues. First and foremost keep in mind that the faculty and advising staff are experienced, dedicated educators that are here to help you achieve your educational goals but at the same time, as an engineering and computer science program, they have a responsibility to ensure standards are maintained and student outcomes are achieved before graduation. The university culture recognizes the value of diversity in multiple dimensions as well as the presumption of expertise and academic freedom of the faculty.

#### **Communicate with your Instructor**

If you have a difference of opinion with your instructor or teaching assistant (TA), or have concerns about technical or administrative aspects of the course, visit the instructor or TA during office hours or contact them via e-mail (if you cannot visit them during the office hours). Express your concerns clearly and respectfully and ask for help. Be sure to provide succinct information about what you have trouble understanding in the course or your concern. Instructors and TAs are here to help. Please remember that you are responsible for pre-requisite knowledge/skills required for a course and regularly studying the material taught in the course. The teaching staff may not be able to help you with your problem if you lack the pre-requisite knowledge/skills or have not been keeping up with the course material. As a guideline, you should be spending three hours studying every week for -each hour of course credit. Thus, you should schedule 8-10 hours each week to devote to each 3-credit course. Also, make sure to resolve the issues as soon as they occur and maintain all documentation. For example, if the assignment instructions are not clear, get the clarification on the day the assignment is assigned and do not wait until the deadline of the assignment.

If, after communicating with your instructor or TA, you are still having problems in the course, connect with your academic advisor to understand your options moving forward.

#### **Connect with your Graduate Program Chair**

If you are unable to resolve the concern after initial contact with the instructor or the TA, and you have met with your academic advisor, you should then connect with the Graduate

Program Chair for your major (or the department offering the course). The Graduate Program Chair will confer with the instructor and/or TA to better understand the concern and try to resolve the problem. Please note that before meeting with the Graduate Program Chair, you should have made a reasonable effort to meet with the course instructor (not just the TA) and get the issue resolved. When contacting the Graduate Program Chair provides all the relevant details such as the course syllabus, assignment handout, e-mail exchange with the instructor, etc. so that the Graduate Program Chair can promptly act on your concerns. Please be brief and precise in the description of your concerns. In some cases, the Graduate Program Chair would like to meet you. When coming for the meeting, please bring along all the relevant documents.

If the instructional concern is not resolved with the program chair or the department offering the course, contact the Associate Dean of Academic Affairs Office for the college offering the course for assistance through the grade grievance process <https://engineering.asu.edu/grade-grievance/>.

### **Remain Focused**

When faced with instructional concerns, it is important to remain focused on the rest of the course while addressing specific areas that are under review. Be sure to stay connected with your academic advisor if there are any changes in your situation.

NOTE:

- Misrepresentation of facts or disrespectful behavior when confronting your instructor or teaching assistant is considered an academic integrity violation.
- Maintain all documentation.
- Act proactively and promptly.

### **In Summary, Guidelines for Avoiding Problems**

- Be sure you have the necessary pre-requisite knowledge before starting a course;
- Attend class and online exercises regularly;
- Devote time each week to studying to avoid getting behind;
- Contact the TA (if assigned) or instructor during office hours at first sign of trouble and come prepared to ask precise questions and to explain your difficulty
- Accept the fact that you grow intellectually and professionally by being challenged and learning to deal with diverse expectations and environments.

### **Process for Resolving Conflicts in Grading, Course Expectations, etc.**

- Contact the TA (if available) or instructor to explain your concern and seek resolution;
- If the TA/instructor has attempted to assist you, but you are still having an academic difficulty that is causing personal stress or hindering your academic success, see your Academic Advisor;
- If the TA/instructor is not responsive or does not provide a legitimate response/accommodation, then contact your Graduate Program Chair.
- If you still feel there is a legal, ethical or procedural violation that is victimizing you, contact the Office of the Associate Dean of Engineering for Academic Affairs.

- Circumventing this process will be considered a violation of professional ethics and protocol.

**Concentration Areas of IE Graduate Courses**

<b>COURSE</b>	<b>TITLE</b>	<b>OR</b>	<b>PSL</b>	<b>IMS</b>	<b>IS</b>
IEE 505	Information Systems Engineering (3)			X	
IEE 506	Web-Enabled Decision Support Systems			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	X	X		
IEE 526	Operations Research in Healthcare	X	X		
IEE 530	Enterprise Modeling (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	Advanced Simulating Stochastic Systems (3)	X	X		
IEE 552	Strategic Technological Planning (3)			X	
IEE 556	Introduction to Systems Engineering			X	
IEE 561	Production Systems (3)		X		
IEE 570	Advanced Quality Control (3)			X	X
IEE 571	Quality Management (3)				X
IEE 572	Design Engineering Experiments (3)				X
IEE 573	Reliability Engineering (3)				X
IEE 574	Applied Deterministic Operations research Models (3)	X	X		
IEE 575	Applied Stochastic Operations Research Models (3)	X	X		
IEE 576	Network Optimization and Algorithms	X	X		
IEE 577	Data Science for Systems Decision Analytics			X	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 Model (3)	X			
IEE 670	Mathematical Statistics (3)				X
IEE 672	Advanced Topics in Experimental Design (3)				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	
CSE 536	Advanced Operating Systems (3)			X	
CSE 550	Combinatorial Algorithms and Intractability (3)	X		X	
FSE 501	Technology Entrepreneurship			X	
FSE 502	Strategic Enterprise Innovation			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
STP 540	Computational Statistics				X
APM 523	Numerical Optimization (3)	X			

OR = Operations Research

PSL = Production Systems and Logistics

IMS = Information Management and Systems

IS = Industrial Statistics

## **COURSE DESCRIPTION**

### **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. Pre-requisite: CSE 205

### **IEE 506 Web-Enabled Decision Support Systems**

Development and analysis of Web-enabled applications for decision support. Topics include: (1) Web application development using ASP.NET; (2) design for computing scalability, interface usability and cyber security; and (3) use of application development skills and design concepts to develop a decision support system consisting of database, analytical data processing, expert knowledge and reasoning, and user-friendly interface for enabling transitions from data to information, knowledge and decisions. Knowledge of database development is necessary to be successful in this course. Perquisite: 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. Pre-requisite: 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. Pre-requisite: 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. Pre-requisite: IEE 470

### **IEE 521 Urban Operations Research**

Probabilistic modeling and analysis of transportation systems (car, bus, train) and emergency service systems (fire, police, ambulance) using functions of random variables, geometric probability, queuing theory, location theory, network analysis and graph applications.

Engineering Graduate student; Credit is allowed for only IEE 421, 498 (Urban Operations Research), 521 or 598 (Urban Operations Research)

### **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. Pre-requisite: Graduate Standing.

**IEE 533 Scheduling**

Provides the basic theory of scheduling and introduction to the applications domain. Pre-requisites: 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. Pre-requisites: IEE 574 or 620

**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. Pre-requisite: 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. Pre-requisite: 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. Pre-requisites: 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. Pre-requisite: 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. Pre-requisite: Engineering graduate student.

**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. Engineering graduate student; Credit is allowed for only IEE 456 or 556.

**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. Pre-requisites: IEE 376 and 470

**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. Pre-requisite: IEE 380.

**IEE 571 Quality Management**

Total quality concepts, quality strategies, quality and competitive iPOsition, quality costs, vendor relations, the quality manual, and quality in the services. Pre-requisite: 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. Pre-requisite: 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. Pre-requisite: 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/MSE/PhD student. Pre-requisite: IEE 376 or IEE 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: Pre-requisites: IEE 376 and 470

**IEE 576 Network Optimization and Algorithms**

Algorithms to solve network flow problems with an objective to improve computational complexity by using appropriate data structures and computing procedures.

Credit is allowed for only IEE 576 or IEE 598 (Network Flows and Algorithms) or IEE 598 (Network Optimization and Algorithms). Prerequisite: IEE 376.

**IEE 577 Data Science for System Decision Analytics**

Focuses on applied data science techniques for the system decision support in PYTHON. Also targets anyone who is interested in data analytics in general or plans to work with data in a future career (such as data scientist and data analytics). Highly encourages some prior knowledge about PYTHON. Focuses on the conceptual understanding of system modeling, statistical and machine learning, and optimization with some mathematical formulation. Also covers the main concept and

some implementation of the latest development in data science, such as distributed computing, large-scale optimization, and deep learning. Furthermore, covers how to implement these models for different types of data, such as tabular data, images, text data. Finally, discusses how to interpret these models for decision support of complex systems. Prerequisite: CSE 110, IEE 380, and IEE 376

### **IEE 578 Regression Analysis**

Regression model building oriented toward engineers and physical scientists. Topics include linear regression, diagnostics, biased and robust fitting, nonlinear regression. Pre-requisites: 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. Pre-requisites: 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/MSE/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. Pre-requisites: IEE 570, 572, 578. At least two of the courses must be completed before registering for this course and the third 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/MSE/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/MSE/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. Pre-requisites: 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/MSE/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 pre-requisites 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. Pre-requisites: 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. Pre-requisites: IEE 470

### **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/MSE/PHD student AND have completed with a C or better IEE 572 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/MSE/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

### **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.

### **Geunyeong Byeon, PhD**

University of Michigan, Ann Arbor (OR, IS)

Operations research and data analytics for supporting decision-making in large, interdependent systems

### **Linda Chaitin, Ph.D.**

State University of New York, Buffalo (IS, OR)

Discrete optimization, stochastic processes and probabilistic modeling, and emergency service location.

### **Adolfo R. Escobedo, Ph.D.**

Texas A&M University (OR)

Theory and application of optimization, mathematical programming error reduction and elimination.

### **Esma S. Gel, Ph.D.**

Northwestern University (OR, PSL)

Applied probability, stochastic processes, queuing theory, stochastic modeling and control of manufacturing systems.

### **Ashif S. Iquebal, PhD (OR, PSL)**

Texas A&M University

Smart manufacturing, data science, unsupervised and active learning, additive and hybrid manufacturing

### **Cheryl L. Jennings, Ph.D.**

Arizona State University (IS)

Quality engineering, quality management, engineering statistics, business analytics

### **Feng Ju, Ph.D.**

University of Wisconsin Madison (OR, PSL)

Stochastic processes, stochastic modeling and control of manufacturing and healthcare systems, battery management systems.

### **Joseph Juarez, Ph.D.**

Arizona State University (IS)

Industrial statistics

**Daniel McCarville, Ph.D.**

Arizona State University (IMS, IS)  
Quality engineering, industrial statistics, engineering management.

**Pitu B. Mirchandani, Sc. D.**

Massachusetts Institute of Technology (OR, PSL)  
Optimization, decision-making under uncertainty, real-time control and logistics, application interests in urban service systems, transportation, and homeland security

**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.

**Theodore P. Pavlic, Ph.D.**

The Ohio State University (OR, PSL, IMS, IS)  
Distributed algorithms, autonomous systems, decentralized decision making, complex adaptive systems, self-organization, hybrid dynamical systems, sustainability in the built environment, behavioral ecology, behavioral economics, operations research, bio-mimicry and bio-inspiration, parallel computation, robotics, energy systems, intelligent control; optimization; game theory; resource allocation; collective behavior

**Giulia Pedrielli, Ph.D.**

Poltecnico di Milano (OR, PSL)  
Simulation methodology, stochastics and learning statistics related to simulation improvement both for performance and evaluation as well as simulation-based optimization of complex systems.

**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.

**Jorge A. Sefair, Ph.D.**

University of Florida (OR)  
Network optimization, robust optimization, integer programming, and applications of optimization in environment, public policy, urban planning, and finance.

**J. René Villalobos, Ph.D.**

Texas A & M University (OR, PSL, IS)  
Logistics, automated quality systems, manufacturing systems and applied operations research.

**Teresa Wu, Ph.D.**

University of Iowa (IMS, PSL)

Information systems, supply chain management, multi-agent systems, data mining, Petri nets, Kalman filtering.

**Hao Yan, PhD**

Georgia Institute of Technology (IS, ISM)

Real time modeling and analysis with large scale high dimensional data, smart adaptive sampling strategy and data reconstruction, data fusion for modeling of complex systems,

**Nong Ye, Ph.D.**

Purdue University (IMS)

Information and systems assurance, data mining and modeling, quality optimization and control systems operations.

## Appendix I - Absent Committee Member Procedure

While it is desirable that all members of a student's supervisory committee be available during the oral exam, prospectus and final dissertation defense, there are situations (e.g. faculty travel, faculty emergencies and/or faculty leave) that may necessitate holding the oral exam, prospectus, or final dissertation defense with one or more committee member(s) absent. The Academic Unit has established the following policies and procedures for such cases.

1. A minimum of 4 committee members (including chair/co-chair) from the student's official committee must be available during the student's oral exam, prospectus, and final dissertation defense.
2. A minimum of 50% of the student's official committee must be physically present with the student at the oral exam, prospectus, and final dissertation defense. If at least 50% of the committee cannot be physically present, the exam/defense must be rescheduled.
3. The chair (or one co-chair) must be available for the oral exam, prospectus, and final dissertation defense. If this is not possible, the exam/defense must be rescheduled.
4. The chair or (one co-chair) must be physically present at the oral exam, prospectus, or final dissertation defense. If this is not possible, the exam/defense must be rescheduled. The student cannot submit a committee change after the defense is scheduled to create co-chairs in the case of an absent chair.
5. A committee co-chair or member who cannot be available during the oral exam, prospectus, or final dissertation defense, may participate in one of three ways. These options are listed in the order of preference:
  - a. The absent committee member videoconferences into the oral exam defense location.\*
  - b. The absent committee member teleconferences into the oral exam defense location.\*
  - c. The absent committee member provides a substitute to be physically present (approved by the committee chair & the head of the academic unit) for the oral exam, prospectus, or final dissertation defense. The substitute must be someone who is approved to serve on graduate supervisory committees for that program. The absent committee member should provide the substitute questions, in writing, to be asked at the exam/defense. The substitute, although respecting the opinions expressed by the regular committee, must be free to use his/her judgment in voting on whether the student passes or fails the defense. The substitute should sign the absent committee member's name, and add his/her initials directly after the signature.

\*The defense location must have the necessary equipment to accommodate video/teleconference materials.

\*Students must provide a copy of their document and any other supporting presentation materials to the committee member at least 5 working days in advance of the defense. The defense location must have the necessary equipment to accommodate video/teleconference materials.

If the videoconference or teleconference option is selected, the absent member needs to e-mail the committee chair or co-chair to state that member voted to pass or fail the student and authorize that the chair sign their name on the form. The committee chair or co-chair should sign

the name of the absent individual on the form and then add his/her initials directly after the signature.

If a committee member will be absent from the oral defense, the student or committee chair/co-chair must notify the Program Chair before or at the time of scheduling the oral exam defense. If the student is notified of an absence after scheduling the oral exam, the student must contact the Program Chair prior to the oral exam defense date, so he/she finds a substitute.

For the final dissertation defense, if a committee member will be absent from the defense, the student or committee chair/co-chair must notify Graduate College before or at the time of scheduling the defense. If the student is notified of an absence after scheduling the defense, the student must contact Graduate College prior to the defense date.