



TEXAS TECH UNIVERSITY
Edward E. Whitacre Jr.
College of Engineering™

Industrial, Manufacturing and Systems Engineering
Department

Graduate Handbook

Master of Science in Industrial Engineering (MSIE)
Master of Science in Systems and Engineering Management (MSSYEM)
Doctor of Philosophy in Industrial Engineering (PhD-IE)
Doctor of Philosophy in Systems & Engineering Management (PhD-SYEM)

A guide for general requirements specific to
the Department of Industrial, Manufacturing and Systems Engineering

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PREFACE

The Department of Industrial, Manufacturing and Systems Engineering (IMSE) at Texas Tech University provides outstanding opportunities for students seeking the Master of Science in Industrial Engineering (MSIE), Master of Science in Systems & Engineering Management (MSSYEM), Doctor of Philosophy with an industrial engineering major (PhD-IE), or Doctor of Philosophy with a systems and engineering management major (PhD-SYEM). The Industrial, Manufacturing and Systems Engineering department dates back more than 75 years. Graduate studies in industrial engineering at Texas Tech have produced over 1,000 M.S. and over 200 Ph.D. graduates, who hold leadership positions in research, manufacturing, government, and consulting organizations.

The graduate faculty invites you to consider our program: faculty, instruction, research and facilities. The following material explains the general procedures, milestones, responsibilities and expectations regarding the M.S. and Ph.D. degrees.

1.0 AREAS OF SPECIALIZATION

The Department of Industrial, Manufacturing and Systems Engineering maintains five primary areas of specialization:

- I. Ergonomics and Human Factors Engineering,
- II. Manufacturing Systems,
- III. Operations Research,
- IV. Statistics and Quality Assurance,
- V. Systems and Engineering Management.

2.0 GRADUATE FACULTY

Graduate faculty with accompanying bios and research interests can be found on the IMSE website.

3.0 APPLICATION AND ADMISSION

Graduate application information and all necessary paperwork can be found from the Graduate School website at: <http://www.depts.ttu.edu/gradschool/>. Completed application forms should be submitted directly through Graduate Admissions. Applications should be completed online using the Graduate School's application system for both the master's and doctorate degrees for all students. The web site is located at: <https://texastechgrad.liaisoncas.com/>.

If an applicant is admitted, admission is granted in two steps: (1) by receiving the initial approval from Graduate Admissions that the application is ready for department review, pending receipt of all necessary application materials, and (2) by receiving the final approval from the Graduate Committee in the Department of Industrial, Manufacturing and Systems Engineering. Applicants for admission are notified of their admission decision by the Graduate Admissions Office using the online application system.

Two levels of admission exist: (1) full admission and (2) conditional admission. Full admission is necessary for ultimately becoming a degree candidate. Candidacy forms are held by the Graduate School until all conditions for full admission are met.

In addition to the two levels of admission, one level of graduate temporary non-degree student status (GTMP) is provided to allow people to enroll in graduate courses for one to two semesters prior to admission or to enable people to take graduate courses for credit without seeking a graduate degree.

Therefore, GTMP students ultimately seeking a graduate degree must gain acceptance from the graduate degree program before the completion of 12 semester hours. Any exception to this rule is granted solely at the Graduate Dean's discretion. In addition, the Department of Industrial, Manufacturing and Systems Engineering only accepts 6 semester hours that were completed as a GTMP prior to the student's acceptance to an Industrial, Manufacturing and Systems Engineering graduate program (in-process courses at the time of acceptance do not count against this limit). Any exception to this rule is granted solely at the Industrial, Manufacturing and Systems Engineering Graduate Committee's discretion. Students who are seeking GTMP status should apply to the GTMP program (not an Industrial, Manufacturing and Systems Engineering graduate program) through the Graduate Admissions Office. The Graduate Admissions Office is the sole party that makes decisions on whether to accept or deny applicants to the GTMP program. Students who are accepted to the GTMP program and subsequently want to gain admission to an Industrial, Manufacturing and Systems Engineering graduate program must submit a change of program application to the Industrial, Manufacturing and Systems Engineering department for consideration. (GTMP students applying to change to an Industrial, Manufacturing and Systems Engineering graduate program must meet the same application requirements and standards as students who initially apply directly to the program).

In order to earn a graduate degree in industrial engineering or systems and engineering management from Texas Tech you must eventually gain full admission status. All applications for admission are processed by the Graduate Admissions Office P.O. Box 41030
Texas Tech University Lubbock, TX 79409-1030 Telephone: (806) 742-2787

In general, graduate admission status remains in effect as long as a student is active in consecutive fall and spring semesters, with or without summer enrollment, and maintains academic performance that meets the current minimum requirements specified by the Graduate School and the Industrial, Manufacturing and Systems Engineering Department. Otherwise, the student must reapply each term he/she intends to be active in the graduate program and readmission is not guaranteed.

3.1 Full Admission to a Degree Program:

Persons who meet the admissions requirements of the Graduate School and the Department of Industrial, Manufacturing and Systems Engineering will receive full (unconditional) admission to the graduate program and are eligible to receive a graduate degree upon successful completion of an appropriate plan of study. Each and every application for graduate studies in the Department of Industrial, Manufacturing and Systems Engineering is carefully evaluated. Prior performance and potential performance for the degree sought are considered. Although some exceptions occur, full admission status requires that the applicant possess a recognized (accredited) degree in an engineering discipline or have successfully completed a leveling program specified by the Graduate Faculty of the Department of Industrial, Manufacturing and Systems Engineering. **Applications are accepted up to 14 days prior to the start of the semester for which the applicant is applying. However, to be guaranteed for consideration for financial assistance, applicants must apply by January 15th for Fall or Summer semester admission and by June 15th for Spring semester admission. These deadlines should strongly be considered for admission and financial assistance for international students in-order to allow sufficient time for travel and visa requirements to be met prior to the first semester of study.**

However, late applications are strongly discouraged as the department cannot guarantee that late applications will be processed in time for the desired admission term nor that these applications will be considered for financial assistance. If the department is unable to finish reviewing an application in time for the desired admission term, the decision will be an automatic rejection of the application. The IMSE department does not consider late PhD applications in most cases.

To be considered for full admission status, a student's application must include:

- (1) an application form;
- (2) transcripts of all previous college work;
- (3) scores from the GRE (Graduate Record Exam);
- (4) one reference letter;
- (5) a non-refundable application fee;
- (6) a departmental questionnaire indicating the student's specific area of interest within industrial engineering

Further, the student must at minimum have completed the following courses in previous undergraduate or graduate coursework:

- (1) 3 hours of college level physics (with lab)
- (2) Calculus I, II, & III

Students without this background will not be admitted to graduate programs in the Department of Industrial, Manufacturing and Systems Engineering; instead, such applicants will be automatically rejected without further review. If a student who does not currently possess this background wishes to be considered for admission, the student must take any missing courses prior to applying and submit transcripts showing a grade of at least a 'C' in each course as part of their application.

In addition to these requirements, a statement of purpose is optional but is strongly encouraged, especially for PhD applicants. The student may also submit a CV/resume or a writing sample if desired.

The GRE is required for both the MS and PhD programs. Students must submit their GRE scores, but admission into the graduate program is not based on the GRE score criteria alone. As a general guide, the Department of Industrial, Manufacturing and Systems Engineering expects successful applicants for the MS programs to possess at least a B average in their last 60 hours of undergraduate work. For work at the PhD level, a 3.5 grade point average in an MS program is expected. Academic performance as a non-degree student (GTMP) may be one factor considered in the admissions process. In addition, the PhD program applicant's credentials are examined to assess his/her potential for in-depth research work, and the fit of the student's credentials and research interests to faculty research interests and availability.

International students are subject to additional requirements as determined by the Graduate Admissions Office. In addition to financial and immigration requirements, international students are required to demonstrate English proficiency. Students should contact the Graduate Admissions Office or visit their website in order to understand the various methods for demonstrating English proficiency, including the minimum scores required on various English proficiency exams.

3.2 Conditional Admission to a Degree Program:

A student may be admitted conditionally to the Industrial Engineering, or Systems and Engineering Management Graduate Program if: (1) his/her undergraduate degree lacks fundamental subject areas (see the Fundamental Requirements section) and/or (2) if the student meets the requirements for admission except for proof of English proficiency. Students must contact their graduate advisors their first semester in the program to see whether conditions are attached to their degree programs. Students, who are admitted conditionally, due to a lack of background in subject areas, will be required to undertake additional study and/or testing to bring their background up to full admission standards. Additional work may take the form of "leveling" course requirements. Leveling work is described in Section 4.

3.3 Temporary Non-degree Student:

A student who has earned a bachelor's degree from a recognized U.S. institution and who was in good standing at the school last attended may be admitted as a "Graduate Temporary Non-degree Student" (GTMP) in non-degree studies. Students are allowed to take graduate courses for one or two semesters without being admitted to the Graduate Program in Industrial Engineering or Systems and Engineering Management. The Department of Industrial, Manufacturing and Systems Engineering may accept course work (up to 6 graduate credit hours) completed at Texas Tech under this classification prior to acceptance, which is consistent with a legitimate plan of study for either the MS or PhD, pending acceptance by the Graduate School and department as described in Sections 3.1 and 3.2.

4.0 FUNDAMENTAL REQUIREMENTS

Successful completion of the graduate program in the Department of Industrial, Manufacturing and Systems Engineering is based on the assumption that the applicant possesses either an accredited engineering degree or the functional equivalent.

Graduate students in the Department of Industrial, Manufacturing and Systems Engineering are expected to possess a mathematical background up to and including Calculus III or the equivalent. This background includes differential calculus and integral calculus. In addition, all students are expected to possess a physical science background including at least 3 hours of college level physics (with lab). If an applicant's transcript indicates the applicant is missing all or part of this background, the applicant will not be admitted (will automatically be rejected without further review).

In addition to the Calculus and physics requirements, students are expected to possess a basic, college-level knowledge in both probability and statistics. Applicant transcripts that do not reflect a course in probability and statistics at either the undergraduate or graduate level will have the admission condition of a leveling course in probability and statistics. Students are expected to complete this leveling early in their graduate programs. Specifically, leveling requirements should be completed in the first half of a graduate student's plan of study, in terms of graduate credit hours in industrial engineering. If sufficient progress in satisfying leveling requirements is not made, the graduate faculty may block enrollment in industrial engineering courses until the leveling requirements are completed. In general, a student may substitute a similar graduate course, if available, for the undergraduate leveling course with advance approval from the student's advisor and the course instructor. A grade of 'C' or better in each undergraduate leveling course or 'B' or better in each graduate leveling course, or their equivalents at another university, is expected. All leveling coursework must be taken for a grade and cannot be taken under the pass/fail option. If the

course(s) are not taken at TTU, the burden of proof for content and completion rests on the student. The student must provide course outlines and other materials to satisfy the student's advisor of the equivalency of the proposed course(s).

5.0 PROGRAM REQUIREMENTS

The Department of Industrial, Manufacturing and Systems Engineering maintains five primary areas of specialization, with a number of courses pertaining to each area:

I. Ergonomics and Human Factors Engineering

- IE 5301. Ergonomics and Design
- IE 5302. Bayesian Analysis for Human Decision
- IE 5303. Work Physiology
- IE 5304. Occupational Biomechanics
- IE 5305. Cognitive Engineering
- IE 5306. Safety Engineering
- IE 5307. Loss Assessment and Control
- IE 5308. Risk Assessment of Human Behaviors
- IE 5309. Human Factors in Engineering and Design
- IE 5371. Bioengineering Systems
- IE 6304. Control Theory for Humans

II. Manufacturing Systems

- IE 5351. Advanced Manufacturing Processes
- IE 5352. Advanced Manufacturing Engineering
- IE 5353. Sustainable Manufacturing
- IE 5355. Computer-Aided Manufacturing
- IE 5356. Biomedical Design and Manufacturing
- IE 5357. Manufacturing Facilities Planning and Design
- IE 5358. Nano-manufacturing

III. Operations Research

- IE 5311. Principles of Optimization
- IE 5312. Queueing Theory
- IE 5314. Multistage Decision Processes
- IE 5316. Simulation Models for Operations Analysis
- IE 5317. Statistical Analysis for Digital Simulation
- IE 5318. Operations Research Modeling with Spreadsheets
- IE 5319. Risk Modeling and Assessment

IV. Statistics and Quality Assurance

- IE 5342. Design of Experiments
- IE 5344. Statistical Data Analysis
- IE 5345. Reliability Theory
- IE 5346. Total Quality Systems

V. Systems and Engineering Management

- IE 5320. Systems Theory

IE 5321. Decision Theory
IE 5322. Industrial Cost Analysis
IE 5323. The Engineering Management Environment
IE 5324. Advanced Economics of Systems
IE 5325. Productivity and Performance Improvement in Organizations
IE 5328. Activity Scheduling
IE 5329. Project Management
IE 6323. Systems Management Global Environment
IE 6329. Systems Management Seminar

VI. Industrial Engineering Courses Independent of Area of Specialization

IE 5331. Theoretical Studies in Industrial Engineering Topics
IE 5332. Independent Study in Industrial Engineering Topics*
IE 6000. Master's Thesis
IE 6331. Theoretical Studies in Advanced Industrial Engineering Topics
IE 6332. Independent Study in Advanced Industrial Engineering Topics *
IE 6399. Research Methods in Science and Technology
IE 7000. Research
IE 8000. Doctoral Dissertation

Catalog course descriptions are provided on the Department of Industrial, Manufacturing and Systems Engineering website.

5.1 Master of Science in Industrial Engineering:

Once admission has been gained (Section 3), the Master of Science in industrial engineering can be earned under one of two programs: (1) the 30-hour non-thesis program or (2) the 30-hour thesis program (see Appendix A for MS Milestone Sequence and Milestone Sequence Flow Chart – Note, students that do not follow the milestone sequence provided in this document can possibly delay their graduation at their own risk). Both programs are offered both on-campus and through distance education (video/internet). In either case, the plan of study and application for candidacy (Program for the Master's Degree and Admission to Candidacy) must be signed by the student's advisor and filed before the submission deadlines published by the Graduate School (typically 6 months prior to graduation). If changes are to be made in the plan of study once it has been approved, the Form for Reporting Changes on Graduate Degree Programs is used and must also be signed by the student's advisor. In addition, an intent to graduate (Statement of Intention to Graduate) must be filed by the student early (usually within the first month) in the term of intended graduation. All necessary forms can be obtained from the Graduate School at: <http://www.depts.ttu.edu/gradschool/>.

Detailed Graduate School deadlines are available from the Graduate School each term. It is the responsibility of each student to comply with the Graduate School deadlines and fees. Students are encouraged to contact the Graduate School early in their final term to verify that they are in compliance with all requirements.

Non-thesis Program. The 30-hour program requires a minimum of 30 graduate credit hours, approved by the student's graduate advisor and the Graduate Dean, and successful completion of the MS final examination (see Appendix A). Students in the MSIE program must complete the MSIE

core (see below and Appendix C) and take at least 5 elective courses, of which at least 3 must be in IE:

1. Operations Research – IE 5311. Principles of Optimization or IE 5318. Operations Research Modeling with Spreadsheets
2. Systems and Engineering Management – IE 5320. Systems Theory or IE 5331 Systems Engineering Process
3. Manufacturing – IE 5351. Advanced Manufacturing Processes or IE 5357. Manufacturing Facilities Planning and Design
4. Statistics – IE 5344. Statistical Data Analysis or IE 5342. Design of Experiments
5. Human Factors/Ergonomics – IE 5306. Safety Engineering or IE 5309. Human Factors in Engineering and Design

The 30-hour program may include up to 6 semester hours of graduate level work transferred from another U.S. university. Transfer courses must be approved by the student's advisor and the Graduate Dean. Considerations include the course content, the strength of the graduate program, and the grade earned (a grade of 'B' or better is required).

As indicated, typically, up to 6 credit hours can be taken in approved non-industrial engineering courses and serve as a minor. If a formal minor is pursued, the student must receive approval from the Minor Department. The student's advisor is responsible for administering the 30-hour MS non-thesis degree option. Note – a maximum of two (2) independent study courses of IE 5332 will be allowed on a student's MS non-thesis plan of study. As described in Section 11.0, only one IE 5332 earned through the department's internship course will be allowed on a student's plan of study, even if a student completes more than one IE 5332 credit through internship. Thus, a student earning one IE 5332 credit through internship may also take an IE 5332 independent study course with a professor and count both on his/her plan of study. However, even if a student completes two IE 5332 courses through internship, he/she cannot count both IE 5332 courses earned through internship toward his/her plan of study, but rather only one. The following additional policies also apply for all IE 5332 credit that is not earned through internship:

- A copy of the course syllabus, including a course title, course description, learning objectives, deliverables (assignments), grading criteria (e.g., points allocated to different assignments), textbook (if applicable) and a course schedule with tentative course deliverable dates, must be submitted to the graduate committee chair before a permit for the course can be issued.
- A CR grade can be initially issued if the student does not complete the course within the enrollment semester. However, the student must complete the course within 12 calendar months of initial enrollment, else the course grade will be converted to an "F," unless the instructor allows an extension.
- A student cannot enroll for additional IE 5332 while they still have a CR grade for a previous IE 5332.

As a requirement for graduation, students pursuing the MS non-thesis option must successfully pass a final comprehensive examination covering their graduate studies. The examination is intended to demonstrate to the faculty that the student has mastered the important concepts, techniques, and methodologies of industrial engineering and can apply them to real world engineering and management problems. The exact content and questions are determined by the examining faculty

committee and may cover all such material that they consider relevant. Efforts are made to include faculty members who have instructed the student in class and/or are familiar with the student's work and area(s) of interest in industrial engineering. The student should request that the exam be scheduled in their last semester. Students must be enrolled during the term in which they take the final examination and complete all other graduation requirements.

If the examination is not passed on the first attempt, it may be repeated once. Under these circumstances, the student will be informed in writing of his/her deficiencies and of recommended steps to correct these deficiencies. It is the Graduate Committee Chair's responsibility to notify the student and the Graduate School of test results.

Thesis Program. The 30-hour thesis program requires a minimum of 24 graduate semester credit hours plus 6 hours of thesis research credit (IE 6000) approved by the student's MS committee. Students in the MSIE program must take at least 1 course in at least 4 of the 5 areas. The 30-hour MS thesis program may include up to 6 semester hours of graduate level work transferred from another U.S. university. Considerations include the course content, the strength of the graduate program, and the grade earned (a grade of 'B' or better is required). The student's plan of study must be approved by his/her committee, his/her graduate advisor, and the Graduate Dean. Note – a maximum of one independent study course of IE 5332 will be allowed on a student's MS thesis plan of study. The following additional policies also apply for all IE 5332 credit that is not earned through internship:

- A copy of the course syllabus, including a course title, course description, learning objectives, deliverables (assignments), grading criteria (e.g., points allocated to different assignments), textbook (if applicable) and a course schedule with tentative course deliverable dates, must be submitted to the graduate committee chair before a permit for the course can be issued.
- A CR grade can be initially issued if the student does not complete the course within the enrollment semester. However, the student must complete the course within 12 calendar months of initial enrollment, else the course grade will be converted to an "F," unless the instructor allows an extension.
- A student cannot enroll for additional IE 5332 while they still have a CR grade for a previous IE 5332.

The master's thesis is expected to represent independent work by the student, conducted under the supervision of his/her graduate committee. It must be written clearly and concisely in English. The focus of the thesis may be an original contribution to the body of knowledge of an area relevant to industrial engineering or a significant application of existing knowledge to a real engineering or management problem. Students are encouraged to draw upon their work experience in defining a thesis topic.

As soon as the student's area for the thesis has been determined, the student is responsible for structuring his/her committee. The committee must consist of at least three members of the graduate faculty, at least two members (or a majority of the committee for larger committees) must be from the Department of Industrial, Manufacturing and Systems Engineering. A formal written plan of study and research proposal must be submitted to the committee, and an oral proposal successfully made, prior to enrollment in IE 6000. All members of the committee must approve the plan of study and proposed topic. The advisory committee is formally appointed by the Graduate Dean, upon the

recommendation of the Department of Industrial, Manufacturing and Systems Engineering. Once enrolled in IE 6000, a student must maintain his/her enrollment each term until he/she defends his/her thesis and completes all other graduation requirements.

With the aid of his/her major professor, the student must complete the research work and then schedule and successfully present and defend his/her thesis to the faculty. The final draft of the thesis document must be submitted to the thesis committee 2 weeks prior to the final defense to allow committee members adequate time to prepare for the defense. All theses must conform to the style and format set out by the Graduate School. It is the responsibility of the student to write the document and work with the Graduate School to meet all thesis style and format requirements and to deliver the proper number of copies to the Graduate School. The Graduate School issues a complete list of deadlines each term, relative to graduation requirements. In addition to the Graduate School requirements, the student is expected to furnish each committee member and the department with a bound copy of the thesis, if requested. The student's major professor is responsible for the administration of the MS thesis program, once a topic and major professor are selected. At the time of the thesis defense, the student must be currently registered in at least 3 hours of IE 6000 under his/her major professor and must have taken at least 6 hours of IE 6000 under his/her major professor up to and including the semester in which the defense is scheduled. After the defense, the major professor will report the defense results to the Graduate School and also assign a letter grade to the last 3 hours of the IE 6000 credits taken, reflecting the student's grade on the thesis.

5.2 Master of Systems and Engineering Management (MSSYEM). The Department of Industrial, Manufacturing and Systems Engineering at Texas Tech also offers a master's degree in Systems and Engineering Management. This degree is offered both on-campus and through distance education (video/internet). This degree has 15 hours of core credits:

1. IE 5320. Systems Theory
2. IE 5321. Decision Theory, IE 5322. Industrial Cost Analysis, IE 5324. Advanced Economics of Systems, or IE 5325. Productivity and Performance Improvement in Organizations
3. IE 5323. The Engineering Management Environment or IE 5329. Project Management
4. IE 5311. Principles of Optimization or IE 5318. Operations Research Modeling with Spreadsheets
5. IE 5316. Simulation Models for Operations Analysis, IE 5319. Risk Modeling and Assessment, or IE 5346. Total Quality Systems

In addition to the 15 hours of core credits, the degree requires 15 hours of elective credits. The MSSYEM can be obtained with a thesis or non-thesis option just like the MSIE, and, except for the difference in the core credits, all the other degree requirements are the same (see Appendix A).

5.4 Doctor of Philosophy: Once admission has been gained (Section 3), the Doctor of Philosophy with a major in industrial engineering or systems and engineering management is earned by completing a minimum of 60 graduate level semester credit hours (beyond the B.S. level) – including 3-15 credit hours of IE 7000 – plus at least 12 credit hours of IE 8000 and the successful completion and defense of a dissertation (see Appendix B for PhD Milestone Sequence and Milestone Sequence Flow Chart – Note, students who do not follow the milestone sequence provided in this document can possibly delay their graduation at their own risk). At least 45 semester credit hours must be completed in industrial engineering or IE-equivalent courses at another university. The 60 credit hours must include at least 30 semester credit hours completed at Texas Tech University, with a maximum of 30 transfer credit hours allowed. Doctoral students with a major in industrial

engineering must take at least 1 course in at least 4 of the 5 areas in the Department of Industrial, Manufacturing and Systems Engineering (transfer courses may be used with approval of the student's advisor).

A minimum of 15 semester credit hours may be completed to serve as a minor (note: a minor is not required). If pursued, the minor area(s) should be chosen to support the PhD research work. If a formal minor is pursued, the student must receive approval from the Minor Department and a faculty member from the minor department must serve on the student's dissertation committee.

A total of up to 30 semester credit hours from a MS program or other previous graduate coursework (completed at TTU or other university) may be counted in either the major area or the minor area or a combination to the two areas. Transfer credit hours are evaluated by the student's advisor as to their applicability to his/her plan of study. Credits completed more than 7 years prior to entry in the PhD program must be justified, in writing, by the student as to their relevance towards the PhD plan of study. The acceptance of such credits is at the discretion of the student's advisor and the Graduate Dean.

The Graduate School requires a "residency" period of each PhD student. Residency normally constitutes full-time study, and to have completed 24 hours within a 12 month period, at Texas Tech. Specific details regarding current residency requirements are listed in the Graduate Catalog. In some cases, a PhD student will be asked by his/her committee to satisfy tool requirements in order to complete the PhD program. Tool requirements consist of courses at either the graduate or undergraduate level and are not counted in either the major or minor course hours.

The PhD dissertation committee will consist of a minimum of four members of the Texas Tech University graduate faculty with Industrial, Manufacturing and Systems Engineering faculty always the majority. In addition, the committee must have at least one outside member who is either from another department at Texas Tech University or from another university (if from another university, the member may come from industrial engineering or a different discipline). It is acceptable to have two (or more) outside members as long as the majority of the members are current Industrial, Manufacturing and Systems Engineering graduate faculty. Outside university members require special approval from the Graduate School in order to serve on the student's committee. Dual degree programs will consist of four members with 2 Industrial, Manufacturing and Systems Engineering graduate faculty and 2 from the other participating university.

Once admission to the PhD program has been obtained, a number of specific requirements must be met (see Appendix B). The listing below provides a sequence of events that must take place in order to earn the Doctor of Philosophy with a major in industrial engineering or systems and engineering management:

- 1. Admission to the Ph.D. Program.** This requirement is discussed in Section 3.
- 2. Plan of Study and Committee.** A formal plan of study, detailing the major and minor courses and the PhD committee, must be approved by the student's advisor and the Graduate Dean. As described above, a PhD committee is typically made up of at least 3 Industrial, Manufacturing and Systems Engineering graduate faculty members and at least 1 graduate faculty member from outside Industrial, Manufacturing and Systems Engineering (for larger

committees, a majority of faculty must always be from Industrial, Manufacturing and Systems Engineering). One of the Industrial, Manufacturing and Systems Engineering faculty members will serve (mandatory) as the committee chairperson or co-chairperson and the research advisor. The composition of the doctoral committee for PhD students (IE or SYEM) in the Joint TTU-ITESM (Instituto Tecnológico de Estudios Superiores de Monterrey) program will consist of a minimum of 4 faculty members – 2 members from TTU IMSE graduate faculty and 2 from ITESM, with 2 of the four professors (one from each institution) serving as co-chairs for the committee. Formulation of a plan of study is primarily the responsibility of the student and his/her major professor. The Doctoral Proposal and Report of Preliminary Examination form (see Graduate School for appropriate forms) is filed with the Graduate School by the student's major professor. Note – a maximum of 2 independent study courses of IE 5332 or IE 6332 will be allowed on a student's Ph.D. plan of study. The following additional policies also apply for all IE 5332 or IE 6332 credit that is not earned through internship:

- a. A copy of the course syllabus, including a course title, course description, learning objectives, deliverables (assignments), grading criteria (e.g., points allocated to different assignments), textbook (if applicable) and a course schedule with tentative course deliverable dates, must be submitted to the graduate committee chair before a permit for the course can be issued.
 - b. A CR grade can be initially issued if the student does not complete the course within the enrollment semester. However, the student must complete the course within 12 calendar months of initial enrollment, else the course grade will be converted to an "F," unless the instructor allows an extension.
 - c. A student cannot enroll for additional IE 5332 while they still have a CR grade for a previous IE 5332.
3. **Qualifying Examination.** Successful completion of a qualifying examination must be accomplished before a PhD student can be admitted to candidacy. The examination is structured by the student's committee and occurs before, during, or in the next long semester after the semester in which the student completes 21 hours at TTU. The format is both verbal and written. Please see Appendix G for more details on the qualifying exam process. A report of the outcome is written by the major professor and submitted to the Graduate School using the Qualifying Exam Report Form. Once a student successfully completes both their Ph.D. qualifying exam and their proposal defense (see step 4), the student must register for IE 8000. IE 8000 registration must be maintained until all graduation requirements are completed. A full-time PhD student must take a minimum of 3 credit hours of IE 8000 per semester (including a minimum of 3 credits hours each summer) once they pass both their qualifying exam and proposal defense until completion of their doctoral program. A full-time student is allowed to take only one, 1 credit IE 8000 semester during the last semester in their doctoral program, if they have successfully defended and only need to turn in final document. Any exception to this policy must be approved by the department chair and the graduate committee. A part-time PhD student must take a minimum of 1 credit hour of IE 8000 per semester (including a minimum of 1 credit hour each summer) once they pass both their qualifying exam and proposal defense until completion of their doctoral program.
4. **Research Proposal.** Each PhD student is responsible for developing a research proposal in writing. This development should be done under the direction of the major professor and

committee. Proposals may vary in length, but are expected to outline the research objective, relevant research questions, and a review of the literature, a proposed research procedure, and a summary of the contributions expected from the research. Research proposals must ultimately be presented to the student's committee and approved by that committee. The research proposal document must be submitted to the dissertation committee at least 2 weeks prior to the defense of the proposal to allow committee members adequate time to prepare for the defense. A PhD student working on their dissertation (or closely related research) with their major professor (i.e., dissertation advisor) should enroll in IE 7000 credit until they have passed both their qualifying exam and proposal defense; after that point, they must enroll in IE 8000 each semester until they complete their final dissertation defense and all other graduation requirements, as discussed above (see point 3). A student working on research unrelated to their dissertation topic with their major professor or another professor must take IE 5332 rather than IE 7000; IE 5332 can be taken at any point before or after the proposal defense. As with IE 8000, a grade will only be assigned to the last three hours of IE 7000, which is expected to correspond with the student's proposal defense. Any other IE 7000 taken will receive only a CR as the proposal defense is not yet complete. A student cannot switch from IE 7000 credit to IE 8000 credit during the semester.

5. ***Dissertation and Defense.*** Once the proposed research is completed, it must be formally reported in the form of a PhD dissertation. The dissertation must be defended by the PhD candidate in an open forum. All PhD students graduating in Spring 2019 must have at least one refereed journal paper accepted for publication prior to the final defense; after Spring 2019, this requirement increases to two papers. These papers do not have to be related to the student's dissertation, although it is expected that most papers will be related to the dissertation. However, they must represent work done at Texas Tech University in collaboration with the student's advisor, the student must be first author, and the advisor must be a co-author (additional co-authors are allowed). Further, the journal the paper is published in must be indexed in Web of Science or Scopus, and the paper must be accepted "As Is" (i.e., formally accepted with full consideration for publication, not accepted with changes) or already published at the time of the defense. At the start of the defense meeting, the candidate must provide evidence of paper acceptance to the committee (e.g., letter from journal editor, or doi information if the paper is already published) or the defense will be cancelled. For students defending prior to Spring 2019, the requirement is that the paper be "submitted," or, if allowed by the committee, "submission ready." The final draft of the dissertation document must be submitted to the committee at least 2 weeks prior to the final defense to allow committee members adequate time to prepare for the defense. In addition, at least 2 weeks prior to the final defense, the student must send a copy of his/her dissertation abstract, as well as a notice of the date, time, and location of his/her defense, to the department's senior business assistant for public distribution to departmental faculty and students as an invitation to attend the defense. All PhD defenses are public (excepting the portions devoted to committee discussions) and a typical defense will include the student, his/her committee and a representative of the Graduate School as well as any other people wishing to hear or challenge the results. A positive vote by the committee as to the technical merit of the research constitutes a successful defense. This vote is reported to the Graduate School by both the Graduate School representative and the major professor. All dissertations must conform to the style and format set out by the Graduate School. It is the responsibility of the student to recruit a Graduate School representative to serve at his/her defense, to write his/her

dissertation document in English, to work with the Graduate School to meet all dissertation style and format requirements, and to deliver the proper number of copies and abstracts to the Graduate School (see Appendix B for details). In addition to the Graduate School requirements for the dissertation, the student is expected to furnish the department and each committee member with a bound copy of the dissertation, if requested. At the time of the dissertation defense, the student must be currently registered in at least 3 hours of IE 8000 under his/her major professor and must have taken at least 12 hours of IE 8000 under his/her major professor up to and including the semester in which the defense is scheduled. After the defense, the major professor will also assign a letter grade to the last 3 hours of the IE 8000 credits taken, reflecting the student's grade on the dissertation.

The student's major professor is responsible for the administration of the PhD program, once a topic and major professor are selected. A summarized sequence of major steps required for the PhD degree is shown in Appendix B. The Graduate School issues a complete list of deadlines each term, relative to graduate requirements.

Dissertation Format – the Department of Industrial, Manufacturing and Systems Engineering at Texas Tech University allows for multiple formats to be used in the composition of a student's doctoral dissertation. One of the formats that is acceptable to the department is the traditional dissertation composed of the following sections: introduction, literature review, research methodology, results and analysis, and research conclusion (with all appropriate bibliographic references and appendices required). Texas Tech University is a research university and expects all PhD students to provide the chairperson of their dissertation committee with at least two accepted journal papers prior to their final defense, as mentioned above. The Industrial, Manufacturing and Systems Engineering Department also allows, and students are strongly encouraged to consider, the use of a modified format that includes all the material presented in the traditional format sections, but constructed in a structure that incorporates three refereed journal publications within the text of the dissertation. The three refereed papers must be of scientific quality and must be at least submitted to approved journals by the time of final defense. (Note, if the student's required accepted papers are not directly related to the dissertation, they do not have to be included in the dissertation document, although the student must still provide evidence of paper acceptance to the dissertation committee as described above; if an accepted paper is related to the dissertation, it can likely constitute one of the three papers). At its discretion, the committee can waive the requirement that the papers actually be submitted for one or more papers, provided the student's advisor can verify that the student has provided the advisor with a "submission ready" version of the paper(s). The chairperson of the candidate's dissertation committee, in conjunction with the dissertation committee, is the determinate of which journals will constitute acceptable venues for submission for publication. The PhD candidate must have prior approval from the dissertation committee chairperson and the dissertation committee for the format to be used in the dissertation document.

6.0 CONTINUATION IN THE GRADUATE PROGRAM

The Graduate School requires that a student earn at least a 3.0 grade point average (GPA) over the courses listed in his/her plan of study (filed with the Graduate School) to be eligible for graduation. Additionally, the GPA for each semester for all graduate courses taken must be at least 3.0 (regardless of the plan of study) for the student to remain "in good standing." An earned semester GPA of less than 3.0 will cause the student to be placed on academic probation. The condition for removal from probation is usually stated as a GPA of 3.0 or greater in the subsequent semester's

work. Failure to merit removal from probation may result in suspension (dismissal) from the Graduate School. In addition to the general requirements of the Graduate School, the Department of Industrial, Manufacturing and Systems Engineering requires that its graduate students receive no more than two (2) grades of 'C' or less in industrial engineering course work. Students who fail to meet this criterion will be dropped from the Graduate Program in Industrial, Manufacturing and Systems Engineering. In addition, all doctoral students will be reviewed by the department on an annual basis to determine whether satisfactory progress in the program is being made. The department may recommend dismissal for those students not making satisfactory progress. Students who are suspended or dropped may petition the Graduate School and department for re-admission.

7.0 ACADEMIC INTEGRITY

It is the policy of Texas Tech University and the Department of Industrial, Manufacturing and Systems Engineering to support and expect a high standard of honesty and academic integrity on the part of its students. The attempt of students to present as their own any work which they have not honestly performed is regarded by the faculty and administration as a most serious offense and renders the offenders liable to serious consequences, possibly suspension. This includes, but is not limited to:

1. Cheating or dishonesty on examinations, quizzes, written assignments, term projects, lab work or other activity. This includes obtaining information during an exam or assignment from an unauthorized source or another student, assisting others in cheating, alteration of grades or records, and unauthorized possession of examinations or other materials.
2. Plagiarism, offering the work of another as one's own without acknowledgment. Any quotation or expression of material taken from any source (e.g. books, journals, the internet, magazines, reports or writings of others) must be explicitly credited as such. Reference guides which have details on style and proper referencing procedures for writing assignments are available at the library and through various websites. All students are responsible for ensuring that written assignments adhere to these guidelines.

Any breach of academic integrity is subject to immediate disciplinary action, at the discretion of the professor and the Office of Student Conduct, which may range from a failing grade on the assignment or exam to a failing grade in the course. At the recommendation of the Office of Student Conduct, a student found guilty of academic dishonesty or plagiarism may be dismissed from the Graduate Program in Industrial, Manufacturing and Systems Engineering. The University's disciplinary policy and procedure is outlined in the Office of Student Conduct website: <http://www.depts.ttu.edu/studentconduct/>.

8.0 FINANCIAL SUPPORT

Financial support awarded on a competitive basis is available within the Department of Industrial, Manufacturing and Systems Engineering. Support consists of three primary forms: (1) scholarships, (2) research assistantships, and (3) teaching assistantships. All scholarships and assistantship appointments require that the recipient be a full-time student and be enrolled in a minimum number of credit hours during their appointment. The number of hours required is determined at the beginning of each term.

Scholarships. A limited number of scholarships are granted each year on a competitive basis. Scholarships applications are available through the Graduate School website at <https://www.depts.ttu.edu/gradschool/financial/FellowshipsScholarships.php>. The deadline for receiving applications each year is January 15. Scholarships are typically granted for the Fall term, cover a 12-month time period, and allow the recipient to pay tuition and fees at "resident" rates. Scholarship awards may vary depending on the availability of funds. All scholarships are awarded for a maximum of one year. A student must reapply each year for future consideration. The department also has a limited number of scholarships available that are granted each year on a competitive basis. New students who apply by the January 15 will automatically be considered for available scholarships on a competitive basis (no separate application is needed). Returning students should watch for notification of the scholarship deadline and application requirements (this notification is typically sent via TTU email by one of the department business managers).

Research Assistantships. Research assistantships are granted by individual faculty members, relative to one of their research projects. Typically, research assistantships are granted on a 0.5 time basis, requiring approximately 20 hours of work per week. Research assistantship appointments are usually made on a term-by-term basis and allow the recipient to pay tuition and fees at "resident" rates for the term appointed, in addition to the assistantship payments.

Teaching Assistantships. Teaching assistantships are granted by the department chairperson, relative to departmental needs and budgets. Typically, teaching assistantships are granted on a 0.5 time basis, requiring the assistant to develop, deliver and/or grade instructional materials. Approximately 20 hours of work per week are expected. Teaching assistantship appointments are usually made on a term-by-term basis and allow the recipient to pay tuition and fees at "resident" rates for the term appointed, in addition to the assistantship payments.

Other graduate scholarship and assistantship opportunities may exist outside the Industrial, Manufacturing and Systems Engineering department (e.g., at a College level or within another department on campus) but the student should contact the potential offering entities directly as the Industrial, Manufacturing and Systems Engineering department neither administers these awards nor maintains a list of such opportunities.

9.0 MINORS IN INDUSTRIAL ENGINEERING

Students who are not majoring in industrial engineering or systems and engineering management are allowed a minor in industrial engineering at both the MS and PhD levels.

9.1 Master of Science Minor: In order to earn an industrial engineering minor at the MS level, a thesis program student must successfully complete a minimum of 6 semester credit hours in approved industrial engineering courses. In addition, a member of the graduate faculty from the Department of Industrial, Manufacturing and Systems Engineering must be appointed to the student's committee. Students in a non-thesis, 30-hour program, are required to complete 9 semester credit hours in approved industrial engineering courses for a minor.

9.2 Doctor of Philosophy Minor: In order to earn an industrial engineering minor at the PhD level, a student must successfully complete a minimum of 15 semester credit hours in approved industrial engineering courses. In addition, a member of the graduate faculty from the Department of Industrial, Manufacturing and Systems Engineering must be appointed to the student's committee.

Students who are interested in a minor should contact the Graduate Committee Chair for information on minor approval and advising.

10.0 FULL TIME STATUS IN THE GRADUATE PROGRAM

Enrollment in 9 or more hours in a long semester and 3 hours in a summer session is considered a “full time” load. A student may be considered “full time” when taking fewer hours, to complete degree requirements in their last semester. A student is allowed only one “last semester” with full time status for less than “full time” enrollment.

11.0 CURRICULAR PRACTICAL TRAINING

A student on an F-1 visa who wishes to complete an internship in industrial engineering while completing his/her graduate program is eligible to do so through Curricular Practical Training (CPT) if he/she meets certain requirements.

1. The student must have completed at least 15 hours of credit at TTU as part of his/her current graduate degree program and must meet any other residency requirements determined by the Office of International Affairs.
2. The internship must be related to Industrial Engineering as determined through examination of the job description in the position offer letter and additional contact by the department chair with the offering company, if needed.
3. The student cannot complete the internship during his/her last semester.
4. The maximum duration of the CPT will be 7 months, regardless of whether the CPT work is completed full time or part time. No extensions to CPT will be permitted.
5. The student will present the position offer letter to the department chair for approval at least two weeks before a response to the company is due. In order to determine whether the position relates to Industrial Engineering, the department chair may ask for additional information about the position from the student and/or the company. If CPT is approved, the student will be issued a CPT approval letter indicating the description of the work (e.g., position name), employer name and address, beginning date, ending date, and semester of registration in the department’s internship course. Specific goals and deliverables of the CPT will be specified as part of the internship course. The project report completed as part of the internship course must discuss the academic theories and models related to the student’s internship experience, with appropriate citations, in addition to describing the applied outputs completed during the internship. In order to be eligible to take the department’s internship course, a student cannot be a permanent employee of the company in which the internship is conducted during the semester of registration.
6. Course Registration – Students must be registered for credit in the department’s internship course for each semester in which CPT is taken. A student may only count 3 hours of the internship course on his/her plan of study. Students enrolled in CPT full time do not have to take other courses during their CPT semester(s), but may elect to. Students enrolled in CPT part time must take at least 6 hours of other course credit during their CPT semester(s). A student can take a maximum of one online (distance) course during each semester of CPT.

12.0 REGISTRATION IN ONLINE COURSES

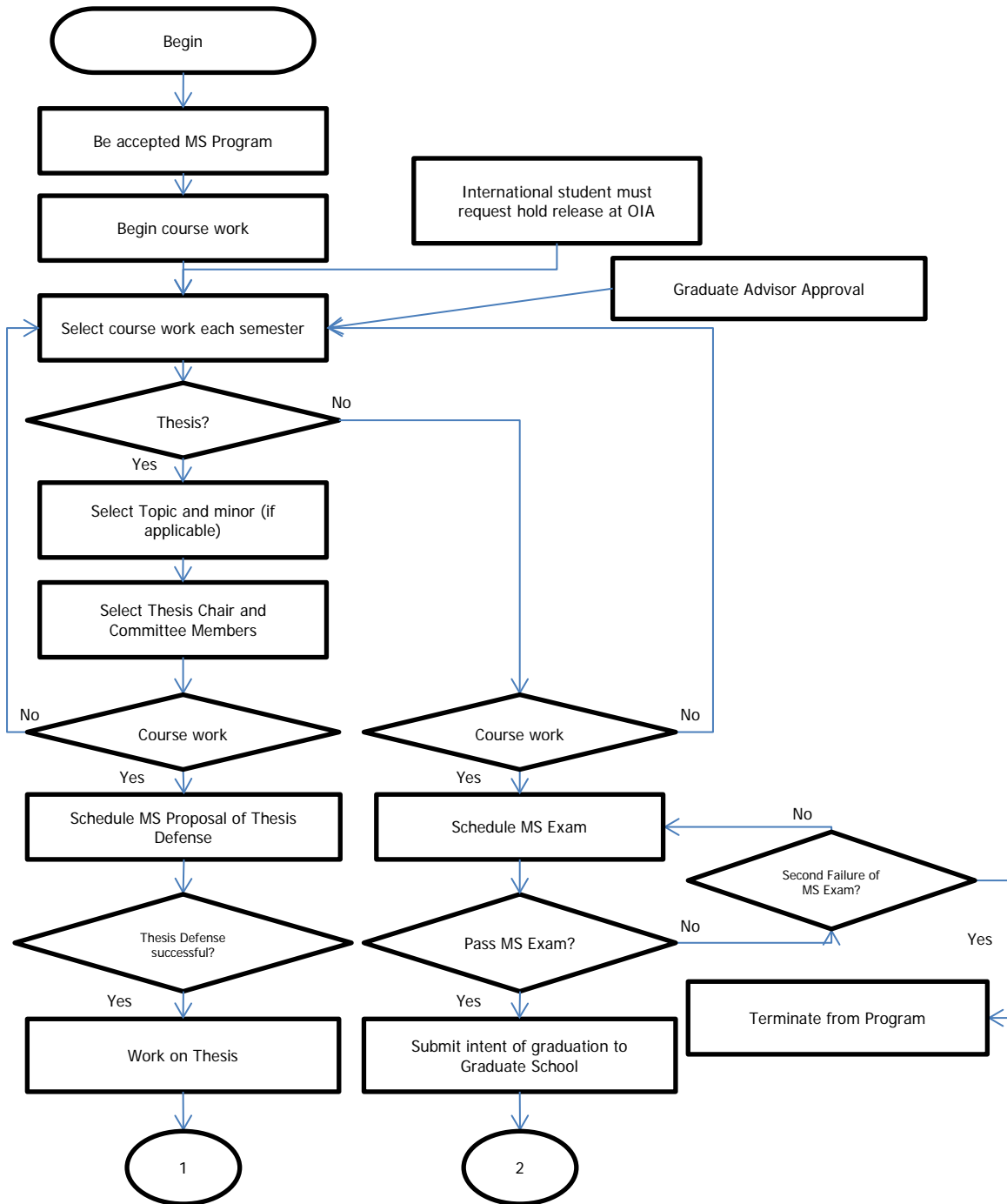
In general, on campus students are not allowed to take online (distance) courses, but instead must take the on campus versions. If a student has a conflict that prevents him/her from taking the on campus version (e.g., conflict with another class or geographic conflict), the student may appeal to the Graduate Committee Chair for an exception. The student should contact his/her advisor to file the appeal and the advisor will then contact the Graduate Committee Chair. Decisions by the Graduate Committee Chair will be made on a case-by-case basis, with input from the graduate committee as needed. Work schedules will generally not be considered sufficient justification unless work schedules are inflexible (e.g., TA for a class that conflicts with the class time or full time CPT).

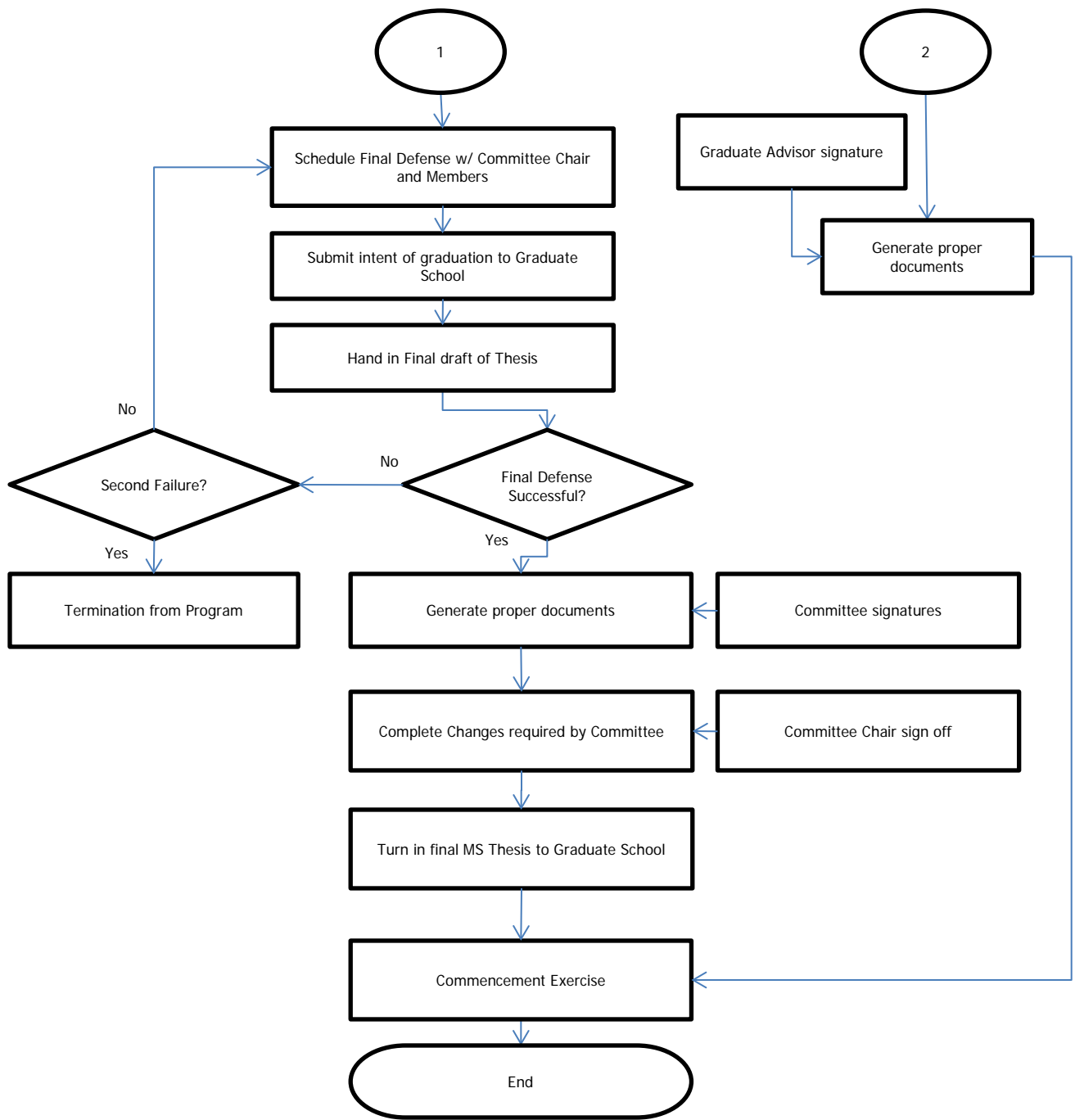
APPENDIX A

MS Milestone Sequence

Sequential Process:

- Be accepted into MS Program (IE or SYEM)
- Begin graduate course work (international students must go to the Office of International Affairs (OIA) before the term begins to get important information about registration, University ID account, etc.)
- Select Thesis Topic and minor area (if applicable) for thesis major; non thesis majors do not need to complete this task.
- Select Thesis Chair (Major Professor) for thesis major; non thesis majors do not need to complete this task.
- Select course work for each semester (this must be approved by the Graduate Advisor)
- If an international student, must request the release of hold from Office of International Affairs
- Select Committee Members and get sign off by selected Committee Members on plan of study (Thesis option only)
- Submit plan of study to Graduate School (must have the graduate advisor signature + minor area advisor signature, if a formal minor is declared)
- Complete core course requirements
- Schedule Proposal Defense of MS thesis with Committee Chair and Members (Thesis option)
- Successfully defend Proposal defense (Thesis option)
- Work on Thesis (Thesis option)
- Schedule Final Defense of MS thesis with Committee (Thesis option)
- Submit intent to graduate to Graduate School in the final semester (term)
- Sign up for MS Comprehensive Exam in the final semester (Non Thesis option only)
- Successfully defend MS Comprehensive Exam (Non thesis option)
- Hand in final draft of Thesis to Committee Members 2 weeks prior to Final Defense (Thesis option)
- Successfully defend Final MS Thesis (Thesis option)
 - Get Committee members signatures
 - Generate proper documents for Graduate School
- Complete changes required by Committee to get the final document for MS Thesis (Thesis option)
- Obtain Committee Chair sign off on final corrections to Thesis (Thesis option)
- Turn in final MS Thesis document to Graduate School (Thesis option)
- Commencement Exercise (graduation)





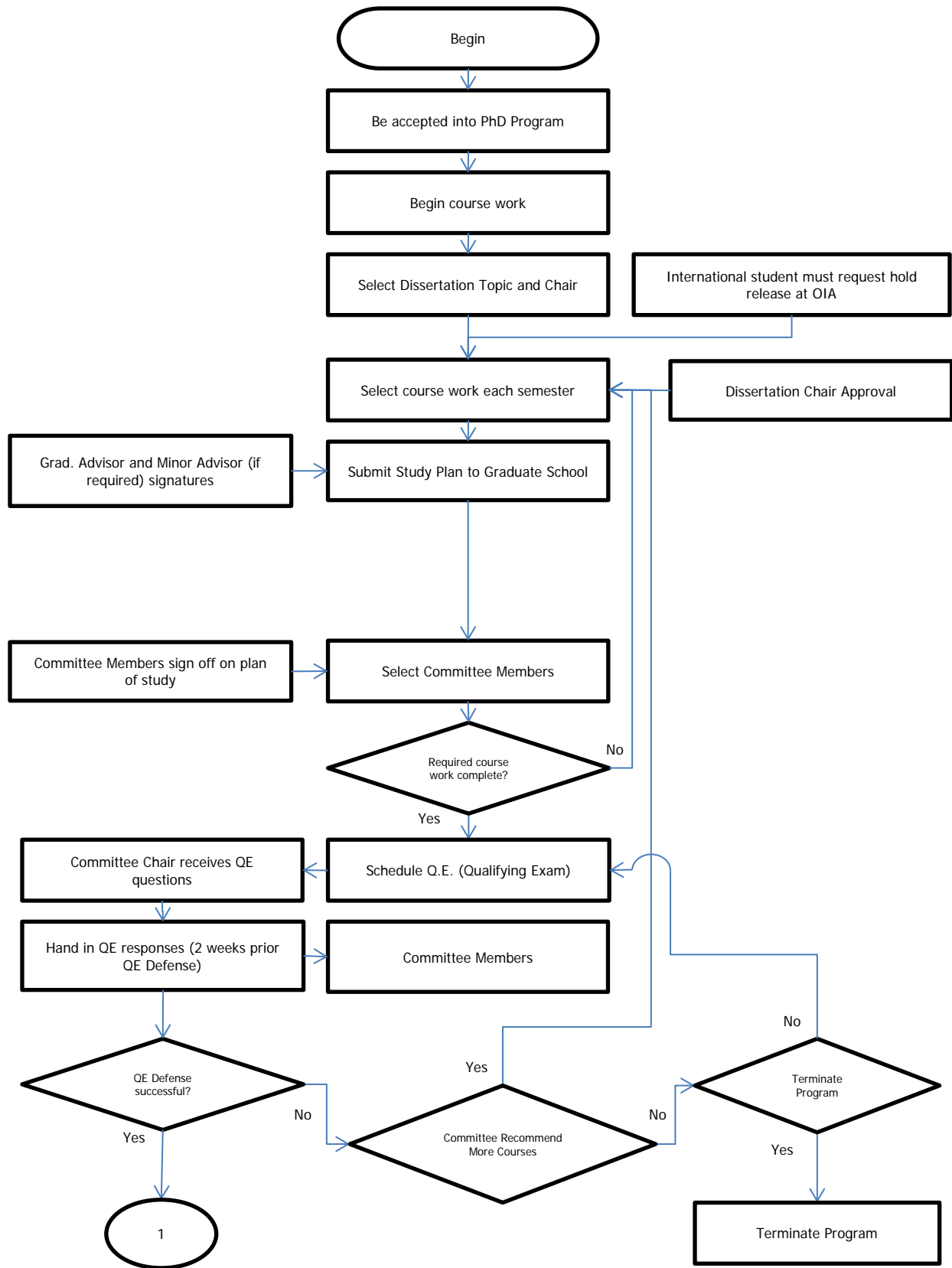
APPENDIX B

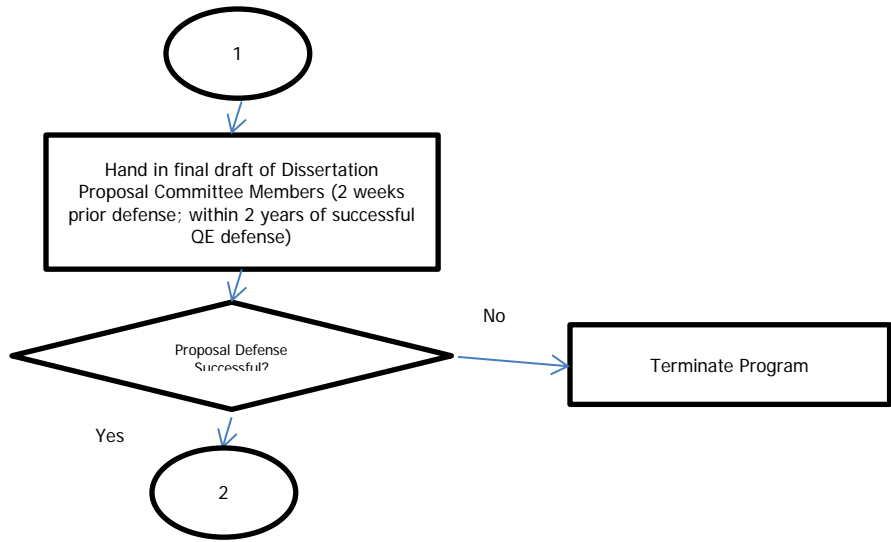
PhD Milestone Sequence

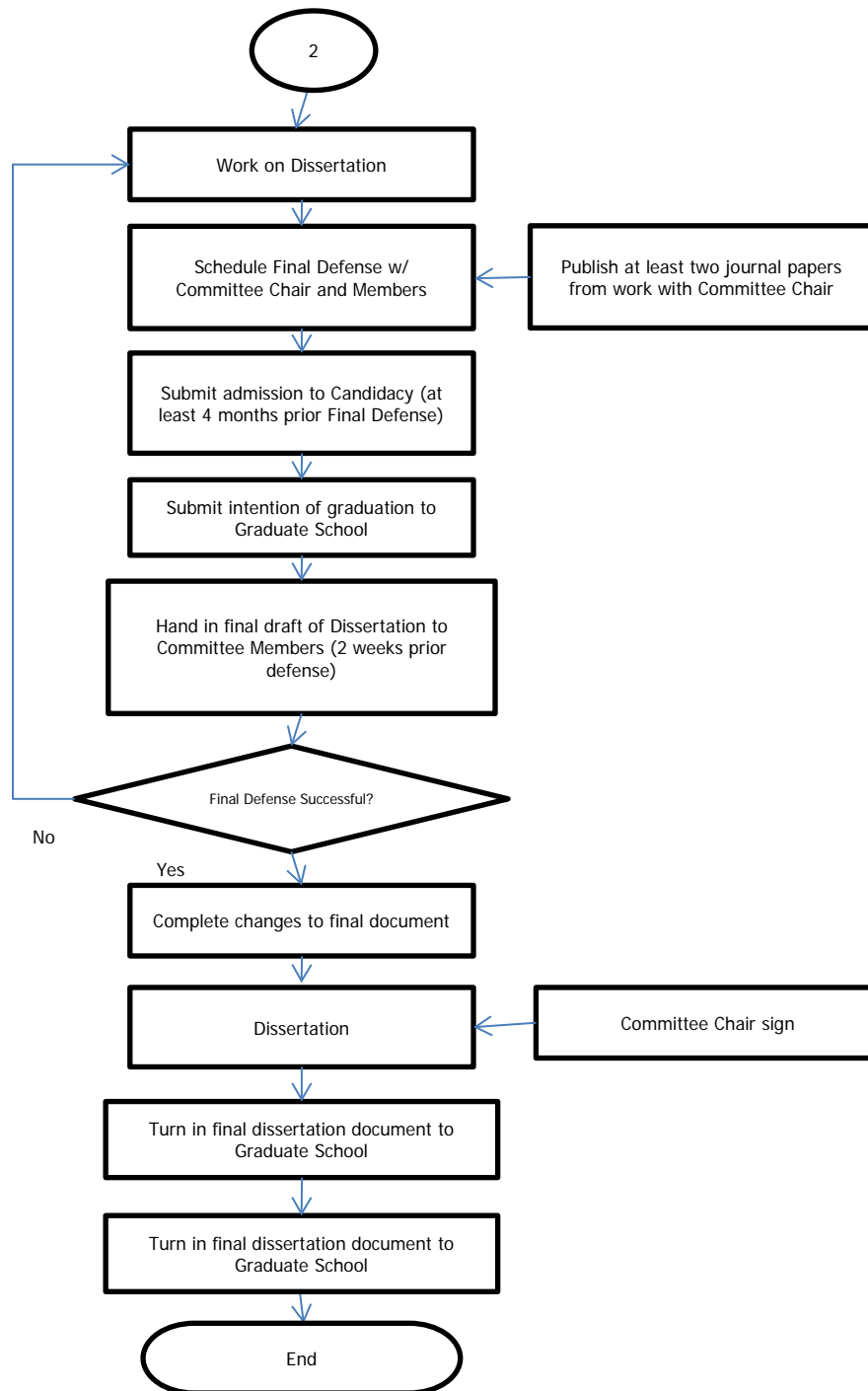
Sequential Process:

- Be accepted into PhD Program (IE or SYEM)
- Begin graduate course work (international students must go to the Office of International Affairs (OIA) before the term begins to get important information about registration, University ID account, etc.)
- Select Dissertation Topic and minor area (if applicable)
- Select Dissertation Chair (Major Professor)
- Select course work for each semester (this must be approved by the Dissertation Chair)
- If an international student, must request the release of hold from Office of International Affairs
- Select Committee Members and get sign off by selected Committee Members on plan of study
- Submit plan of study to Graduate School (must have the dissertation advisor signature + minor area advisor signature, if a formal minor is declared)
- Complete core course requirements
- Schedule Qualifying Exam with the Committee Chair and Committee Members and Submit Pre-Proposal to Committee Members at least 4 weeks prior to exam
- Committee Chair receives Qualifying Exam questions from Committee Members and submits to student
- Hand in written Qualifying Exam responses to Committee approximately 2 weeks prior Qualifying Exam Defense
- Successfully defend Qualifying Exam
 - Written responses to questions from Committee Members
 - Oral Defense of written responses to Committee Members
- Successfully defend Dissertation Proposal
- Work on Dissertation
- Publish at least two refereed journal papers from work with the Committee Chair
- Schedule Final Defense with Committee Chair and Members
- Submit admission to candidacy at least 4 months prior to Final Defense
- Submit intent to graduate to Graduate School in the final semester (term)
- Submit final draft of Dissertation to Committee Members at least 2 weeks prior to Final Defense
- Submit abstract and notice of defense to department at least 2 weeks prior to Final Defense
- Successfully defend Final Dissertation
 - Get Committee members signatures

- Generate proper documents for Graduate School (requirements)
- Complete changes required by Committee to get the final document of Dissertation to Committee Chair
- Obtain Committee Chair sign off on final corrections for Dissertation
- Turn in final Dissertation document to Graduate School
- Commencement Exercise (graduation)







APPENDIX D
Course List (PhD IE)
DOCTOR OF PHILOSOPHY - INDUSTRIAL ENGINEERING
GRADUATE COURSE OF STUDY

Name:	ID#:	
Date Entered Program:	150-HR Program	POS Filed
Leveling Required:	YES NO	COMPLETE
email:	Advisor:	
Semester	Cumulative GPA	

Ergonomics and Human Factors

POS	COURSE	SEM	GRADE
_____	IE 5301	_____	_____
_____	IE 5302	_____	_____
_____	IE 5303	_____	_____
_____	IE 5304	_____	_____
_____	IE 5305	_____	_____
_____	IE 5306	_____	_____
_____	IE 5307	_____	_____
_____	IE 5308	_____	_____
_____	IE 5309	_____	_____
_____	IE 5371	_____	_____
_____	IE 6304	_____	_____

Operations Research

POS	COURSE	SEM	GRADE
_____	IE 5311	_____	_____
_____	IE 5312	_____	_____
_____	IE 5314	_____	_____
_____	IE 5316*	_____	_____
_____	IE 5317	_____	_____
_____	IE 5318	_____	_____
_____	IE 5319	_____	_____

Engineering Management

POS	COURSE	SEM	GRADE
_____	IE 5320	_____	_____
_____	IE 5321	_____	_____
_____	IE 5322	_____	_____
_____	IE 5323	_____	_____
_____	IE 5324	_____	_____
_____	IE 5325	_____	_____
_____	IE 5328	_____	_____
_____	IE 5329	_____	_____
POS	COURSE	SEM	GRADE
_____	IE 5331	_____	_____
_____	IE 5332	_____	_____

Statistics

POS	COURSE	SEM	GRADE
_____	IE 5342	_____	_____
_____	IE 5344	_____	_____
_____	IE 5345	_____	_____
_____	IE 5346	_____	_____

Manufacturing

POS	COURSE	SEM	GRADE
_____	IE 5351	_____	_____
_____	IE 5352	_____	_____
_____	IE 5353	_____	_____
_____	IE 5355	_____	_____
_____	IE 5356	_____	_____
_____	IE 5357	_____	_____
_____	IE 5358	_____	_____

QUALIFYING EXAM/PROPOSAL DEFENSE

POS	COURSE	SEM	GRADE
_____	IE 7000	_____	_____

DISSERTATION - FINAL GRADE

POS	COURSE	SEM	GRADE
_____	_____	_____	_____

OTHER COURSES

POS	COURSE	SEM	GRADE
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

*Texas Tech IE Undergraduates may not take this course.

LEVELING REQUIREMENTS

	SEM	GRADE
IE 3341 - Engineering Statistics	_____	_____
Other	_____	_____

APPENDIX G

PhD Qualifying Exam Process

- Timing of the exam:
 - o A student must complete their first attempt at the exam by the next long semester after the semester in which they complete 21 hours at TTU (i.e., transfer coursework does not count toward this total). E.g., suppose a student completes 9 hours in Fall 2019, 12 hours in Spring 2020, and 6 hours in Summer 2020; in this case, they crossed the 21 hour threshold in Spring 2020 and would be required to take the qualifying exam by the end of Fall 2020 (they could complete the exam before that, if they and their dissertation committee chair feel it is appropriate and if they meet the other requirements – see below).
 - o In general, students must have completed at least 15 hours at TTU (again, not counting transfer coursework) in order to be eligible to take the exam. However, if a student wishes to take the exam prior to completing 15 hours at TTU, they can petition their dissertation committee chair and the IMSE graduate committee for an exception.
 - o Prior to taking the exam, PhD IE students must have courses in at least 4 of the 5 IMSE areas (see IMSE graduate handbook) completed or in process, while PhD SYEM students must have at least 4 PhD SYEM core courses completed or in process. A maximum of one course can be transferred in to meet this requirement (i.e., at least 3 of the 4 courses required for the exam must taken at TTU). Students must have also filed a PhD degree plan prior to the date of their exam.

- Exam format:
 - o The exam will be administered by the student’s dissertation committee (see the IMSE graduate handbook for the requirements for dissertation committees). Thus, a student must have both a dissertation committee chair and committee in order to take the exam.
 - o A minimum of 4 weeks prior to the qualifying exam date, the student must provide the committee with a pre-proposal which uses one of the following formats:
 - *Option 1:* A 10-20 page “white paper” which will contain: a) an introduction to the problem (the problem they intend to address, the motivation behind the problem, the general research questions and initial versions of the hypotheses); b) a brief literature review (to demonstrate the current state of knowledge related to the problem as well as the research “gap”); and c) a brief overview of the methodology (data collection and analysis procedures).
 - *Option 2:* An accepted or published refereed paper (journal or conference), written by the student on work done at TTU, and of no fewer than 6 pages, plus a 1-5 page document describing how the student intends to extend the work in the paper for their dissertation research. In most cases, it is expected that the student would be the first author of the refereed paper and the student’s dissertation committee chair would be a co-author. Note: the student must

- provide the committee with appropriate proof of acceptance/publication of the paper.
- The student should also recognize that many faculty may wish to see the pre-proposal prior to agreeing to serve on a student's committee; thus the student should anticipate that they may need to provide the pre-proposal to prospective committee members significantly earlier than 4 weeks before the qualifying exam.
- Within 5 business days of the student sending the pre-proposal to the committee, the student's dissertation committee chair should send a request for qualifying exam questions to the other committee members and set the official start date of the student's qualifying exam. The student is responsible for finding a date, time and location for the committee to meet for the oral portion of the qualifying exam, and must determine and communicate this to the committee no later than the official start date of the exam set by the student's dissertation committee chair. The oral portion of the qualifying exam must occur 4-6 weeks from the official start date of the exam set by the student's dissertation committee chair.
 - After receiving the call for qualifying exam questions, each committee member will have 2 weeks to review the student's pre-proposal and to send at least one qualifying exam question to the student (and their dissertation committee chair).
 - The intent of the qualifying exam is to test the student's ability to do PhD-level research, not to primarily focus on re-testing the student on coursework completed at TTU (or a previous institution). However, the questions can, and often do, relate to concepts covered in courses at TTU or other institutions.
 - Thus, the exact format of the qualifying exam question(s) is up to each committee member, e.g., essay, problem-based, etc. However, the question(s) should typically relate to the general topic of the proposed dissertation research or a related topic (e.g., a student may propose to use a certain methodology, but the committee member might ask them a question about an alternate methodology).
 - Questions that test a student's general ability to conduct PhD-level research are also appropriate (e.g., ability to create a proposal for funded research, ability to review a journal paper).
 - After the 2 week period for the receipt of questions concludes, the student will have 2 weeks to respond in writing to all of the qualifying exam questions. The student must submit their answers to all of the qualifying exam questions to all of the committee members at the end of the 2 weeks via email or hard copy (depending on each committee member's preference as to format). Each committee member will receive the answers to all questions asked not just to their questions. While working on the qualifying exam questions, a student may ask a committee member for clarification of the meaning of their question, but not for instructions on how to complete it. Also, while a student should use outside published sources to answer the questions, they should not consult or work with any other outside parties on the exam questions.

- The oral portion of the qualifying exam will occur no more than 2 weeks after the submission of the written answers. During the oral portion, each committee member will ask the student questions related to the written qualifying exam questions and answers. (Note: a committee member can ask questions related to any of the written qualifying exam questions and answers, not just the ones they asked). Each committee member will consider both the student's written and oral responses in determining an overall grade of "Pass" or "Fail" for the exam. A student who receives no more than one "Fail" vote (each committee member will vote individually) will Pass the exam. The date and time for the oral portion of the qualifying exam must be determined no later than the official start date of the exam, and 90 minutes should be scheduled for the oral portion of the qualifying exam, to allow adequate time for committee discussion and voting (it is anticipated that the actual question and answer period with the student will typically take around one hour). Students must complete the oral portion of the qualifying exam either on campus or via Skype in the presence of an approved proctor. In addition to the Pass/Fail result, a Passing or Failing student may also have additional coursework requirements added to their plan of study based on committee feedback on the exam, e.g., if the committee believes the student is deficient in a certain area related to their research, the committee can require additional course(s) in that area be added to the student's plan of study, even if this causes the student to go above the minimum 60 hours of coursework. A student must satisfactorily complete any such deficiency coursework prior to their proposal defense.
- If the student fails their first attempt at the qualifying exam, they will be allowed to retake the exam no less than 4 months and no more than 6 months later. Each student is only allowed one retake on the exam. A student can also elect not to retake the exam and instead to leave the PhD program (applying to switch to the MS would usually be an option). A student who does not retake the exam within 6 months will be terminated from the PhD program.
- After passing the qualifying exam, the student must successfully defend their proposal within 2 calendar years. A student who does not successfully defend their proposal within 2 years from the qualifying exam will be terminated from the PhD program. As previously noted, a student must complete any deficiency coursework requirements set by the committee at the qualifying exam before their proposal defense. After passing both the qualifying exam and the proposal defense, the student must register for IE 8000 credit each subsequent semester until defending their final dissertation and completing all other graduation requirements (see Section 5.4 for more details).