

IME Graduate Program Handbook

Department of Industrial & Manufacturing Engineering
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Introduction

This handbook describes the Industrial & Manufacturing Engineering (IME) Graduate program at North Dakota State University (NDSU). The IME graduate curriculum, Plan of Study (POS), policies, regulations and procedures applicable to the student pursuing a graduate degree are contained herein. This handbook contains policies and procedures that apply specifically to the NDSU IME Graduate Program in addition to the requirements by the College of Engineering and the NDSU Graduate School. Students may also refer to the documentation provided by the Graduate School for additional information regarding the policies and procedures that apply to all graduate students. This document is also intended to:

- Be a resource for graduate students and faculty in the IME Department;
- Provide information related to policies, procedures and forms required by the Graduate School; and
- Help students to design a schedule that will assist them in graduating in a timely manner.

Information about course descriptions, faculty and current research areas can be found on the IME Department website (<http://www.ndsu.edu/ime/>)

Useful Websites for NDSU Graduate Students

- Department of IME: <http://www.ndsu.edu/ime/>
- College of Engineering (COE): <https://www.ndsu.edu/coe/>
- NDSU Graduate School: <http://www.ndsu.edu/gradschool/>
- Graduate School forms: http://www.ndsu.edu/gradschool/graduating_students/forms/
- Financial Information: http://www.ndsu.edu/gradschool/current_students/fellowships_and_awards/#c264658
- Guidelines for the Preparation of Dissertations, Theses and Papers: http://www.ndsu.edu/gradschool/graduating_students/dtp/format/
- NDSU Graduate Bulletin: <http://www.ndsu.edu/gradschool/bulletin/>
- NDSU Policies: <http://www.ndsu.edu/policy/>
- NDSU Equal Opportunity and Diversity: <http://bulletin.ndsu.edu/student-resources-policies/#policiestext>
- Admissions Policies: <http://bulletin.ndsu.edu/graduate/admission-information/>
- Privacy of Records: <http://www.ndsu.edu/bisonconnection/ferpa/>
- One Stop service center identification cards, financial aid, tuition, student records, class schedules, etc.: <https://www.ndsu.edu/onestop/>
- NDSU Schedule of Offered Courses: <https://www.ndsu.edu/onestop/connect/schedule/>
- PHD Dissertation Video: http://www.ndsu.edu/gradschool/graduating_students/dissertation_video/

NDSU IME Graduate Program

The IME Department at NDSU offers two graduate degrees in Industrial & Manufacturing Engineering: 1) Master of Science (M.S.) and 2) Doctor of Philosophy (Ph.D.). Industrial & Manufacturing Engineering is one of six engineering graduate programs in the College of Engineering (CoE).

Mission Statement

Teaching Mission: To provide high quality undergraduate and graduate programs in industrial and manufacturing engineering.

Research Mission: To advance knowledge of manufacturing and industrial engineering, strengthen and support industry and enhance teaching.

Service Mission: To participate in faculty governance, in the broader community of the engineering profession and its disciplines and in the land grant mission of the university through engagement in state, regional and national affairs.

Our Vision

To be globally recognized as a dynamic contributor to the development and dissemination of advanced knowledge in the diverse field of Industrial and Manufacturing Engineering. We will create a nourishing environment that facilitates the growth of individuals through innovative teaching and imaginative research and scholarship.

Guiding Principles

Excellence. We will strive for the highest quality and utility in education, research, service and outreach.

Integrity. We will uphold the highest professional and ethical standards of conduct.

Diversity. We will value differences in people, perspectives and ideas.

Collegiality. We will respect the work of others and strive for collaboration.

Inclusivity. We will continuously seek input from students, faculty, employers and alumni.

Stewardship. We will effectively use resources entrusted to us.

1. Admission to the IME Graduate Program

Admission to the IME Graduate Program is granted on a competitive basis. Because the IME Department often receives many more qualified applications than can be accepted, admission standards each year may be higher than the minimum requirements listed below. In general, however, admission is dependent upon the following items:

- Undergraduate/graduate GPA and other scholar activities;
- Graduate Record Examinations (GRE) scores;
- TOEFL or IELTS scores (for international students);
- Area of interest; and
- IME Faculty members availability to advise students in a particular area of interest.

When a student is admitted, the department expects that the student will graduate in a timely manner. See Time Limitations, 2.13. Because admitting a student represents a significant commitment of the IME faculty and the department, we strive to assure all students that are admitted can succeed in graduate school. When a student is admitted, the faculty members in the IME Department are committed to supporting students to develop the skills needed in the field of industrial and manufacturing engineering.

1.1 Application Procedure

For general information about Graduate School (GS) admission procedures, see the General Admissions information provided by the Graduate School.

(<https://bulletin.ndsu.edu/graduate/admission-information/>)

Prospective students should apply online directly through the Graduate School website. In general, the following items will be required:

- Graduate School application form
- Application fee
- Copies of all undergraduate and graduate transcripts
- Official report of the GRE general test score
- Official results from the Test of English as a Foreign Language (TOEFL) or International English Language Testing Systems (IELTS) (for international students)
- “Statement of Purpose” identifying immediate and ultimate degree objectives, technical areas of interest, and career objectives
- Three letters of recommendation

The Graduate School only processes applications accompanied with the application fee. Once the complete application materials have been received, they will be forwarded to the IME Department for consideration.

1.2 Admission Deadlines

Fall Semester

Application deadline for full consideration of available assistantships	Mar. 1
Notification of admission/assistantships	Apr. 1
Student response required	Apr. 15

Spring Semester

Application deadline for full consideration of available assistantships	Aug. 15
Notification of admission/assistantships	Sep. 1
Student response required	Oct. 15

University Requirements: Domestic applications must be received 1 month prior to registration. International applications must be received prior to May 1 for Fall Semester and prior to Aug. 1 for Spring semester. To be considered a domestic applicant, you must: be a citizen or a permanent resident of the United States of America at the time you apply for admission, or hold refugee, asylee, or jay treaty status.

1.3 Minimum Admission Requirements

All applicants are expected to have the following minimum requirements:

- B.S. degree or M.S. degree in industrial engineering, manufacturing engineering, or a closely related field (such as mathematics, statistics, computer science, business, economics, information science; other degrees may also be considered on a case-by-case basis)
- A minimum GPA of 3.0 (on a 4.0 scale) for admission at full standing; or be earning at least a 3.0 GPA over the past two semesters of graduate studies at an accredited institution.
- A minimum GRE score of 310 (Combined Quantitative and Verbal) with a minimum Quantitative score of 160 and Analytical Writing score of 3.5;

International students, in addition to the above requirements, are also expected to have the minimum scores on the TOEFL or IELTS exams as listed below:

TOEFEL Paper	TOEFEL Computer	TOEFEL Internet	IELTS
550	213	79	6.5

Table 1 Minimum Scores on TOEFL & IELTS for Admission of International Students

The IME **department code** is 67 and the NDSU **code** is 6474.

If the applicant's academic background is exceptionally outstanding, reconsideration of the minimum requirement(s) is possible, based upon a case-by-case consideration determined by the Graduate Program Coordinator and/or Department Chair of the IME Department.

If the number of qualified applicants exceeds the number of graduate student positions available, the requirements to gain admission may exceed those listed above. In special circumstances, a student not meeting the requirements listed maybe conditionally admitted if they are supported by a faculty member and satisfy the minimum admission requirements set forth by the NDSU Graduate School.

TOEFL/IELTS required for Graduate Teaching Assistantships may exceed those listed above, in accordance with the NDSU English Language Proficiency requirements found in the NDSU Graduate Bulletin. See Chapter 2.6.

1.4 Graduate School

The Graduate School has a variety of campus-wide policies and procedures that apply to all students enrolled in a graduate program. Graduate school applicants should initially contact the graduate school to submit their applications. Admission letters will be issued by the Graduate School.

Graduate School Forms:

The following forms may be downloaded from the Graduate School website

(http://www.ndsu.edu/gradschool/current_students/forms/)

- Request for Change: Plan of Study or Advisor/POS committee
- Request to Schedule Examination
- Master and Doctoral Plan of Study
- Continuation of Program/Degree Objective Change
- Request to Withdraw from the Graduate School
- Report of Preliminary Exam (created by the ME Office)
- Report of Final Exam (created by the ME Office)
- Request for Delayed Enrollment
- Request for Reactivation
- Request for Leave of Absence
- Commencement Participation
- Degree Application/Exit Survey

Contact Information

Mailing Address:

NDSU Graduate School
NDSU Dept 2820
PO Box 6050
Fargo, ND 58108

Physical Address:

NDSU Graduate School
106 Putnam Hall
1349 12th Ave NW
Fargo, ND 58102

Email: ndsu.grad.school@ndsu.edu

Phone: 701-231-7033

Fax: 701-231-6524

2. Information for IME Graduate Students

2.1 IME Graduate Program Coordinator

The **contact information** of the IME Graduate Program Coordinator (IME-GPC) is as follows:

Dr. Yiwen Xu
Assistant Professor and IME Graduate Program Coordinator
Department of Industrial & Manufacturing Engineering
NDSU Dept 2485
PO BOX 6050
North Dakota State University
Fargo, ND 58108-6050
yiwen.xu@ndsu.edu

The Graduate Program Coordinator is appointed by the Department Chair. Duties include the following:

- Graduate student application processes and maintain records of all graduate student applications for admission.
- Maintain familiarity with university and department requirements for admission and assistantships.
- Work with the IME Graduate Committee to review and revise (as necessary) departmental standards for admission.
- Respond to inquiries from prospective graduate students.
- Oversee graduate program requirements and curriculum.
- Review and approve Plans of Study and other required forms for graduate students.
- Act on behalf of the IME Graduate Committee during the summer, seeking other faculty input when appropriate.

2.2 IME Graduate Committee

The IME Graduate Committee consists of the Graduate Program Coordinator (Committee Chair) and other faculty members from the IME Department. The primary function of the Committee is to develop and implement policies associated with the graduate program, make recommendations concerning graduate student admission and granting of assistantships, and review recommendations from the IME Faculty concerning the course and curriculum development. Activities include, but are not limited to:

- Development of academic goals, policies, and procedures related to the IME graduate program.
- Administration of graduate academic policies and procedures (graduate admissions, approval of Plans of study, etc.).
- Approval of student petitions for exceptions to IME Department policies.
- Continual review of the graduate curriculum, evaluation of the ability to meet the stated goals, and proposals for needed curricular revisions.

2.3 Major Advisor

All incoming graduate students will be assigned a faculty advisor. Students recruited directly by an individual faculty member in the IME Department will be assigned that faculty member as their advisor. For all other students, the Graduate Program Coordinator with consultation with the

Department Chair, will be assigned as their initial faculty advisor, who will assist with the admission process, first-semester course selection, and obtaining a regular major advisor.

A major advisor should be sought by the end of their first semester of study and must be tenure track Professor. The major advisor, who typically is an expert in the student's area of interest, will serve as the student's mentor and will assist the student in preparing their Plan of Study (POS). The major advisor serves as the thesis/dissertation director and chair of the POS committee, provides guidance in the selection of a research topic, and supervises the research project. Students can have a single major advisor or co-major advisors, where multiple faculty members are chosen to share the advising task. They will help ensure that the student makes satisfactory progress towards completion of the degree.

In the case when there is a change in the major advisor, ethical behavior requires that the student consult with their first major advisor before making a commitment to a new advisor.

2.4 POS Committee

The POS committee serves to help guide the student as they investigate their research topic and develops their skills in conducting original research. Because POS committee, including the student's major advisor, are empowered to help the student develop their technical and research skills to conduct Master's level or PhD level research, the student is expected to meet with the POS committee throughout their graduate studies. It is expected that they meet at a minimum of once a year.

The POS committee for a **Masters** student must consist of at least **three** faculty members:

- The Major Advisor who chairs the POS committee
- A full or associate member of the IME Department graduate faculty
- A faculty member from outside the student's program, or an NDSU Graduate School approved qualified off-campus expert in the field

The POS committee for a **Doctoral** Candidate must consist of at least **four** members:

- The Major Advisor who chairs the POS committee
- A full or associate faculty member of the IME Department graduate faculty
- A faculty member from outside the student's program, or an NDSU Graduate School approved qualified off-campus expert in the field
- The Graduate School Appointee, who is an NDSU Faculty member from outside the IME Department

The Graduate School appointee should be invited to meetings but is not required to attend. At a minimum, the student must meet with the POS committee to present their research proposal no later than one semester before the final defense. Regular meetings with the major advisor and committee members allow the faculty and the student an opportunity to work together in developing their research and technical skills. It also allows the faculty members to keep the student on track for graduating in a timely fashion, as well as refining their Plan of Study as new courses and new interests arise.

Students that fail to meet with their major advisor and/or POS committee on a regular basis after the Plan of Study has been submitted may indicate to the major advisor that the student is not making progress or no longer interested in pursuing a graduate degree at NDSU.

2.5 Plan of Study

All students must consult with their major advisor and submit a Plan of Study by the end of the second semester of study. After being completed by the student and reviewed by the major advisor, the Plan of Study must be submitted to the IME Graduate Program Coordinator and then to the NDSU Graduate School through the IME Office for approval.

2.6 Support and Funding

Financial support for graduate students may come from the IME Department or through research grants administered by individual faculty members. A full-time assistantship consists of 20 hours/week; graduate assistants on full assistantships are not allowed to work on a second assistantship without prior approval from the Graduate Dean (i.e., 20 hours/week maximum). Any graduate student working 10 or more hours per week may be eligible to receive a full or partial tuition waiver as well as a salary (stipend), subject to the NDSU policies in effect at the time of enrollment. Financial support is available in the form of Graduate Research Assistantships (GRAs), Graduate Teaching Assistantships (GTAs), and Graders.

The standard monthly stipend for a 20 hours/week workload typically ranges from \$1,000 to \$1,500, depending on the funding availability of the department. The actual amount will be based on a number of factors, such as degree (MS compared to Ph.D.), productivity, such as publications, patents, professional activities, GPA and other key performance indicators. Typically, the department will support a GTA or grader at \$1,000/month for MS students and \$1,200/month for Ph.D. students. In the case of exceptional performance, these ranges can be exceeded. In addition, GRAs are based on external funding sources. The funding source will define the stipend, but will generally follow the above guideline amounts.

In order for a student to receive support from the IME Department, they must be a U.S. citizen or have a valid F1 Student Visa one week prior to the beginning of the semester.

GRAs

Funding for Graduate Research Assistantships (GRAs) comes from grants or contracts received by faculty members from various agencies. As a stipulation of these awards, the faculty member(s) is responsible for seeing that the proposed research is completed in a timely manner as well as for assuring quality of the research. GRAs are often paid a base salary, and may receive a tuition waiver as well. Typically, in addition to fulfilling the requirements of the contract, the research funded by the grant serves as the foundation for the student's thesis or dissertation, providing in-depth knowledge into their particular field of research.

Each faculty member is responsible for selecting their own GRAs. Often, students may start as a GTA or Grader, and then change to a GRA once they identify a faculty member as their major advisor. It is possible, however, that the students with outstanding credentials may enter as GRAs. Prospective students are likewise encouraged to contact faculty members in their areas of interest to inquire about GRA positions.

GTAs and Graders

The IME Department has limited support for hiring Graduate Teaching Assistants (GTAs) and Graders. GTAs may be responsible for teaching undergraduate-level courses or laboratories for the department. Graders are responsible for grading homework, quizzes, exams, etc. for individual courses. GTA and grader assignments are assigned by the Department Chair. Assignments are based on laboratory components and IME department policy not by instructor/advisor. In return for their work, they receive a salary and may be eligible for a full or partial tuition waiver if they

work 10 hours or more for the department.

To be eligible for GTA or Grader positions, international students must meet English Language Proficiency requirements specified by the Graduate School. The accepted measures of language proficiency are the internet-based TOEFL (iBT) and IELTS. The minimum test score requirements for GTA and Grader positions are listed below.

	Total Score		Speak Score		Writing Score	
	iBT	IELTS	iBT	IELTS	iBT	IELTS
Grader	79	6.5	19	5.5	21	6.0
GTA	81	7.0	23	6.0	21	6.0

Table 2 TOEFL & IELTS Minimum Scores for Getting Assistantship

Students may serve in the capacity of a grader for no more than one calendar year. To continue as a GTA, students must meet the he GTA requirements listed OR successfully complete LANG 701 English Language and Classroom Skills for International GTAs AND LANG 702 English Language Tutorial for International GTAs.

All graduate students who receive assistantships from the Department should successfully take and pass any safety and annual training as well as the sexual harassment training as required by the University. NDSU Graduate School withdraws the Tuition Waiver for students who have not completed their training.

2.7 Enrollment Status and Credit Load

Nine credits are considered a full-time graduate load for students not receiving departmental support (assistantship). To receive assistantship, students must be enrolled at least five credits. Graduate assistants working 20 hours per week are considered full-time if registered for five or more graduate credits. Federal law requires all **international students** with a 20 hour per week assistantship to carry at least **six credits for full-time status.** Loan deferment may also require full or half-time status. Eligibility varies with financial aid programs and students should contact their lender or the Financial Aid Office for requirements.

Students enrolled in less than half time credits and being supported by NDSU may be subject to FICA withholding on their wages. Students should contact the NDSU Payroll Office for information prior to enrolling part-time.

Graduate students wishing to register for more than the standard maximum of 15 credits in a regular semester need to secure approval from their Department Chair as well as from the Dean of the Graduate School. The request should include, 1) How many credits they in which they are currently registered, 2) How many additional credits in which they wish to enroll and 3) Justification for the request. The Department Chair will review the request, and if approved, will forward it on to the Dean of the Graduate School.

Summer Semester

Summer Semester Credit requirements may vary depending on assistantship eligibility requirements. Check with the Financial Aid office to determine the amount of credits in which you are eligible to enroll. In addition, international students should check with their international programs advisor to verify their eligibility requirements.

Tuition waivers may be available for the summer semester if a student worked sufficient hours to be eligible for the waiver in the spring. Students may also be hired on an assistantship during the summer, but must enroll in at least 1 credit and work 160 hours over the summer months.

2.8 Graduate Student Orientation

All new graduate students are encouraged to attend the orientation organized by the Graduate School. There will be a separate IME Departmental orientation at the beginning of each semester and all graduate students are expected to attend.

Office Space

Office space is available on a limited basis to M.S. and Ph.D. graduate students. Students should contact their major advisor regarding available spaces. Priority will be given to students with research or teaching assistantships.

Should the office space be abused by disrespecting fellow students, misusing department property or negligence, office space privileges will be revoked.

Keys/Card Access

Graduate students frequently require keys or card key access to offices, laboratories, and the buildings. The major advisor must approve the requests for card/key access for their student(s) through the IME office. The student will be expected to complete all necessary safety training and submit all certificates of completion to the IME Office before access will be granted.

Safety Training Seminars

All graduate students are required to attend any mandatory safety training seminars as provided by NDSU and the IME Department's Safety Committee.

2.9 Advising and Registration

Each semester, prior to registration, students will meet with their advisor to enrolling in the upcoming semester. Registration for classes, for the most part, should be completed by April 30 (for Fall Semester) and November 30 (for Spring Semester). After these dates courses will be evaluated, and those with less than the required minimum enrollment may be at risk of cancellation. Written permission from the advisor is required to register for all master's thesis and doctoral dissertation credits. Permission will be forwarded on to the IME academic assistant to remove the restriction.

2.10 The Graduate Courses

A list of graduate courses offered by the IME Department can be found in the NDSU Campus Connection System. Students can register for cross-listed courses. Cross-listed courses are courses listed in the course catalogs of more than one department. The "home department" of a cross-listed course is the department in which the course is normally taught. A cross-listed course with the IME Department is considered to be an IME course, regardless of the section in which the student is enrolled.

2.11 IME Department Graduate Series Seminars

To supplement the student's formal coursework and research experience, the IME Department offers a Graduate Seminar series. All full-time graduate students are expected to attend these seminars. Attendance will be taken at each seminar and will be used as a factor when evaluating students for fellowships, scholarships, and assistantships. The attendance record of all GTAs and GRAs will be reported to the students' major advisor.

Seminars will be scheduled, on average, every other week, with approximately 6-8 in each fall and spring semester. They may be offered by graduate students, faculty members within the IME

Department, or by students, faculty, or visiting researchers from outside the department. Each student over the course of three semesters in which they are enrolled is required to present one seminar per year.

All funded graduate students are required to enroll in the IME Graduate Seminar (IME 790) for three semesters, per degree, during their pursuit of the M.S. degree and/or Ph.D. degree. The required enrollment for self-funded graduate students is one semester. IME 790 is offered as a required course and grades will be given only as pass/fail. Every student is required to attend at least two-thirds of the regularly scheduled IME Graduate program seminars each semester in which they are enrolled to receive a passing grade (unless otherwise noted). Any student who attends less than the required number of seminars may petition the IME Graduate Committee, in consultation with the student's major advisor, to make up the missed seminars (e.g., by attending seminars offered by other departments).

2.12 Co-op/Internship Work Experience

The IME Department encourages graduate students to pursue cooperative education or internship opportunities when available. However, students who wish to pursue such opportunities should notify their major advisor well in advance of the employment dates so that appropriate arrangements can be made. Prior to acceptance of a co-op/internship opportunity, it is expected that the student will have completed all coursework and a majority of the research, and submitted a draft copy of the thesis or dissertation, unless alternative arrangements have been approved by the major advisor.

2.13 Time Limitations

Graduate study for the Ph.D. degree in industrial & manufacturing engineering requires a minimum of three years, and more typically four to five years for full-time study beyond the baccalaureate degree. A student who has a Master's degree must devote at least one academic year of study towards the Ph.D. degree in residency at NDSU.

Graduate credit for any course work that is more than 7 calendar years old at the time of the final defense cannot be used to satisfy degree requirements for an M.S. degree. In addition, any coursework that is more than 10 years old at the time of the final defense cannot be used to satisfy degree requirements for a Ph.D. degree. Under special circumstance a student may petition for a waiver of these requirements

(https://www.ndsu.edu/fileadmin/gradschool.ndsu.edu/Forms/Student_Forms/Extension_request.pdf), after getting the permission from the POS members.

The final defense must be repeated if the final copy of the approved thesis/paper/dissertation is not delivered to the Graduate School or if any other degree requirements have not been completed within one year of the date of the final defense.

If a period of time, two years or greater, lapses before the final copy is submitted, the student must reapply to the Graduate School, re-defend the thesis and must register for a minimum of two credits. Degree date is based on the date when final copies are submitted to the Graduate School.

2.14 Dismissal from the Graduate Program

The progress of each graduate student will be reviewed by the student's major advisor each semester. If a student's progress is unsatisfactory, the student may be subjected to probation or dismissal from the IME Graduate Program.

Conditions for Dismissal

Any graduate student who has completed 12 or more hours of graduate coursework and who has not attained at least a 3.0 cumulative GPA will be subject to probationary status. If the student does not fulfill the 3.0 cumulative GPA requirement in the subsequent semester (following probationary status), the student may be dismissed from the program.

Any student who has completed the formal coursework and/or residency requirements, but is not making satisfactory progress toward the completion of the remaining degree requirements (for example, research progress), may be dismissed from the program.

Dismissal Procedure

For any student subject to dismissal, the student's major advisor and POS committee will be consulted prior to making a final decision. The dismissal is effective at the end of the semester in which the decision is made.

The student will be notified in writing of the potential dismissal within four weeks in which the decision is made. The student may appeal the decision of dismissal within four weeks of notification by submitting a letter to the IME Graduate Committee.

2.15 Petition to the Graduate Committee

This handbook includes the general policies and procedures for the IME Graduate Program. In rare cases, a student may have legitimate reasons for deviating from these general requirements. In such cases, the student must submit a letter to the IME graduate Committee to request special consideration.

2.16 Leaving the Department

Students are required to return the key(s) for the office, laboratories and building; clean up office/lab spaces; and return any department-owned books, solution manuals, computers, or other equipment. The IME Department also requests contact information from graduates in order to keep a profile of all alumni. In addition, the student is required to provide all laboratory log books and data (software files, etc.), to the major advisory.

3. M.S. Program in Industrial & Manufacturing Engineering

The IME Department offers M.S. degrees in *Industrial Engineering and Management* and in *Manufacturing Engineering*. Both degrees require a final defense (see Chapter 3.2).

This section of the graduate handbook is intended to help students enrolled in the M.S. program, their major advisors, and their POS committees during the student's work on their Master of Science Degree in the IME department. This section includes:

- The IME department philosophy and a short description of the M.S. degree program.
- Summary of the roles and responsibilities of the student, their advisor(s), and their POS committee.
- List of milestones and requirements a student needs to meet in order to earn an M.S. degree.

The philosophy of the IME Department with the M.S. Program is to empower the student, their major advisor and POS committee to tailor the student's studies according to his/her background, skills, interests, and challenges within the student's area of interest.

This philosophy makes it imperative that the student begin working closely with their major advisor and POS committee as soon as possible. The student can expect the following:

- The student's major advisor will typically be an expert in the student's area of interest and will have the greatest knowledge of what is required to complete M.S. level research in the student's chosen area.
- The student's POS committee members will typically be experts in related areas, which can provide greater breadth of knowledge than one person can provide

Together, the student's major advisor and POS committee help guide the student towards completion of his/her M.S. degree by:

- Helping to develop the student's technical skills (i.e. helping to develop a Plan of Study) to the point where he/she has the skills necessary to conduct research at the M.S. level.
- Helping the student learn what is involved in conducting original research at the M.S. level.
- Helping to develop the student's research skills.

It is understood that it is the responsibility of the student to assure all of the required component of the degree be met in a timely and professional time. This philosophy places responsibility of watching the student's progress on the major advisor and the POS committee for overseeing the student's progress, and if necessary, terminating the student's studies if the student is not making sufficient progress.

3.1 The Requirements

The master's degree requires a total of 30 credits of study and is open to students who have previously earned a bachelor's degree in a related engineering discipline. Students from other disciplines may be admitted to graduate study in either the industrial engineering and management or the manufacturing engineering discipline, but may need additional preparation in discipline-specific prerequisite topics.

The M.S. thesis typically documents the student's first exposure to the research process, however represents a significant outcome of the student's academic career. While the M.S. thesis can be based on the theory of previous work, it must present and defend new knowledge that was generated by the student. This document often includes:

- Problem statement (the objective, or hypothesis, of the thesis).
- Explanation of present knowledge related to the problem.
- Research question or hypothesis
- Presentation of the new knowledge created by the student in meeting this objective, or in testing the hypothesis.
- Experimental design
- Findings/results
- Conclusions

The requirements for how thorough and significant the latter two sections are determined by the student’s major advisor and POS committee. Students who select the thesis option need to work closely with both their major advisor and POS committee as they move forward on the research.

Course Credits (24 credits)

- A minimum of 15 credits from *didactic IME* courses (numbered IME 601-689 and IME 700-789) are required.
- In addition, a minimum of 6 credits of *other courses* are required for funded student (no matter GTA or GRA). This part of the course credits may come from approved graduate level courses of other departments. If a student is funded by himself/herself, then the minimum requirement of other courses is 8 credits.
- A minimum of 3 credits (i.e., from three semesters) from IME *graduate seminar* (IME 790) are required for a funded student (no matter GTA or GRA). If a student is funded by himself/herself, then the minimum requirement of the graduate seminar is 1 credit.

	Funded Students	Self-funded Students
Didactic IME courses (numbered IME 601-689 and IME 700-789)	15 credits	15 credits
Other courses (approved graduate level courses of other departments)	6 credits	8 credits
Graduate seminar (IME 790)	3 credits	1 credit

Table 3 Course Requirement of the M.S. Program

M.S. Thesis Credits (6 credits)

- 6 credits of thesis (IME 798) are required towards the M.S. degree.
- All graduate students are required to submit two articles to a refereed journal or refereed conference based on their thesis research.

Additional Requirements

For students admitted without an IME degree, they may be required to show proficiency in basic industrial and manufacturing engineering subjects such as methods (IME 311) and manufacturing processes (IME 330). Additionally, all students are required to take a minimum of *three courses* from the following:

- IME 611 Human Factors
- IME 630 Process Engineering
- IME 631 Production Engineering

- IME 640 Engineering Economy
- IME 656 Project Management
- IME 660 Evaluation of Engineering Data
- IME 661 Quality Assurance & Control
- IME 670 Operations Research I
- IME 672 Simulation
- IME 680 Production and Inventory Control

Thesis Proposal

The purpose of the thesis proposal is to allow the student to demonstrate their ability to identify a problem in their area of interest and formulate a strategy on how to apply their skills in addressing the problem. During the proposal phase, the student is not expected to have any concrete results, but rather an understanding of the problem and how they might approach it.

The thesis proposal is to be both a written and oral presentation on what the student proposes to work on for their M.S. thesis. A 2-6 page written proposal should be delivered to the POS committee at least one week before the oral presentation of the proposal. The oral presentation must be held no later than one semester prior to the final thesis defense but preferably with the first semester of the students work. The content of the proposal should include the following:

- Objective of the student's work, or the hypothesis they wish to investigate.
- Explanation of why this topic is significant.
- Literature review and an explanation of what others have done in the area.
- Explanation of what methods the student proposes to use to attack this problem.
- Speculation on what the results may be.
- Timeline for completion of the work.
- Deliverables.

3.2 M.S. Thesis Defense

Each student in the M.S. program must present their thesis in an oral defense administered by the student's major advisor and POS committee. At least two weeks prior to the defense, the student will submit the final copy of their thesis/paper to their committee as well as submit a Request to Schedule Final Exam Form to the IME Office for Graduate School approval.

A negative vote by any one member of the student's committee will signify failure of the defense. The student may repeat the exam only upon permission from a majority of their committee. A second attempt may take place at least one month after the failed exam as determined by the committee. Should the exam be failed twice, the student will not be given a third exam except by recommendation of the examining committee, program administrator, and special approval of the Dean of the Graduate School following consultation with the Graduate Council.

The Approval Page required by the Graduate School, will not be signed until all revisions have been approved by the examining committee.

Continuous enrollment is required until all degree requirements are completed, including submitting final copies of a thesis, paper, or dissertation.

3.3 Summary of the M.S. Program

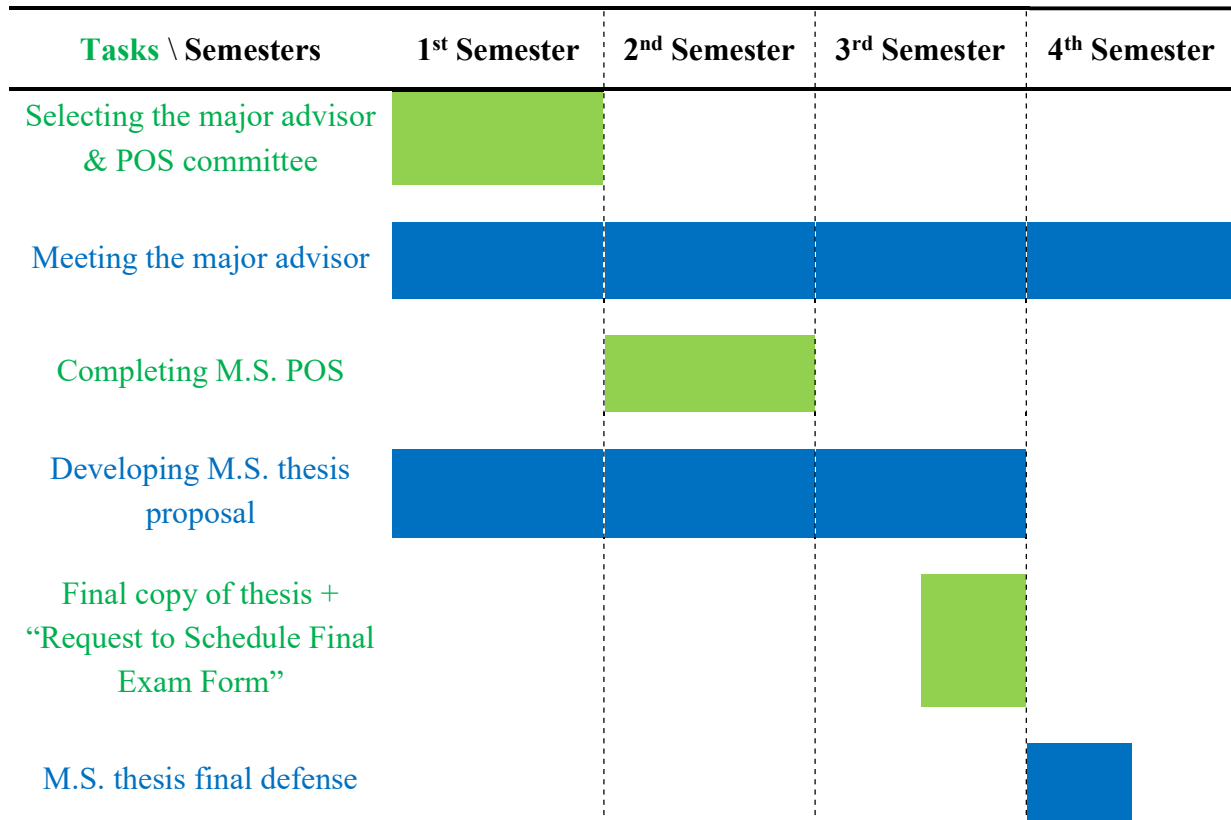


Figure 1 Recommended Progress Chart of the M.S. Program (Based on A Total of Two-years Study)

4. Ph.D. Program in Industrial & Manufacturing Engineering

All doctoral degrees awarded in the IME Department are in the combined discipline of Industrial and Manufacturing Engineering. Doctoral students seeking specialization in selected fields within either industrial engineering or manufacturing engineering can determine their concentration through elective coursework and selection of dissertation topic.

This section of the graduate handbook is intended to help students enrolled in the Ph.D. program, their major advisors and their POS committees during the student's work on their Ph.D. degree in the IME Department. This section includes:

- The IME Department philosophy and a short description of the Ph.D. program.
- Summary of the roles and responsibilities of the student, their advisor, and their POS committee.
- Requirements for the Ph.D. degree in industrial and manufacturing engineering.
- List of milestones and requirements a student needs to meet in order to earn their Ph.D. degree.

The philosophy of the IME Department with the Ph.D. Program is to empower the student, their major advisor, and POS committee to tailor the student's studies according to his/her background, skills, interests, and challenges within the student's area of interest.

The milestones and requirements described herein are intended to be minimal in nature, subject to the requirements of the NDSU Graduate School. It is expected that they will often be expanded as necessary by the student's major advisor and POS committee in order to ensure that the student receives the background they will need upon leaving NDSU.

This philosophy makes it imperative that the student begin working closely with their major advisor and POS committee as soon as possible. The student can expect the following:

- The student's major advisor will typically be an expert in the student's area of interest and will have the greatest knowledge of what is needed to conduct Ph.D. level research in the student's chosen area; and
- The student's POS committee members will typically be experts in related areas, which can provide greater breadth of knowledge than one person can provide.

Together, the student's major advisor and POS committee will help guide the student towards completion of their Ph.D. degree by:

- Helping to develop the student's technical skills (i.e. developing a Plan of Study) to the point where they have the skills necessary to conduct research at the Ph.D. level;
- Helping the student learn what is involved in conducting original research at the Ph.D. level; and
- Helping to develop the student's research skills (i.e. developing the student's dissertation proposal for the student's comprehensive/preliminary exam).

This philosophy places responsibility on the major advisor and the POS committee for overseeing the student's progress and, if necessary, terminating the student's studies if the student is not making sufficient progress.

4.1 Ph.D. Program Course Credit Requirements

For students who are enrolled with a M.S. degree, the course credit requirements *beyond the M.S.* degree are:

- A minimum of 15 credits from *didactic IME courses* (IME 601-689 and 700-789), with at least 9 credits from 700-level IME courses. If courses are not offered in a timeline that meet the students requirements, it is possible for waiver/substitution requests.
- A minimum of 12 credits of *other courses* are required. This part of the course credits may come from approved graduate level courses of other departments.
- A minimum 3 credits of *Graduate Seminar* (IME 790).
- A minimum of 30 credits of *dissertation* (IME 899).

For students who are enrolled with a bachelor’s degree, the course credit requirements are:

- A minimum of 30 credits from *didactic IME courses* (IME 601-689 and 700-789), with at least 9 credits from 700-level IME courses. If courses are not offered in a timeline that meet the student’s requirements, it is possible for waiver/substitution requests.
- A minimum of 27 credits of *other courses* are required. This part of the course credits may come from approved graduate level courses of other departments.
- Among these 57 course credits, at least 30 of them must be 700-level course. For example, if you take 9 credits of 700-level IME courses, then you need to take at least 21 credits of 700-level courses of other departments.
- A minimum 3 credits of Graduate Seminar (IME 790).
- A minimum of 30 credits of dissertation (IME 899).

The following table summarizes these course requirements.

	Enrolled with M.S. Degree	Enrolled with B.S. Degree
Didactic IME courses (numbered IME 601-689 and IME 700-789)	15 credits, with a minimum of 9 credits from 700-level IME courses	30 credits, with a minimum of 9 credits from 700-level IME courses
Other courses (approved graduate level courses of other departments)	12 credits	<ul style="list-style-type: none"> • 27 credits • Including the abovementioned didactic IME courses, at least 30 credits among the total 57 course credits must be 700-level.
Graduate seminar (IME 790)	3 credits	3 credits
Dissertation (IME 899)	30 credits	30 credits

Table 4 Course Requirements of Ph.D. Program

The student's academic POS committee must approve all courses taken outside of the IME Department (Typically in advance). The total course of study need to be approved by the student's POS committee and department chair. Students completing graduate degrees within the IME Department are expected to exhibit demonstrable expertise in the core competencies of either industrial engineering or manufacturing engineering.

Additional Requirements

For students admitted without an IME degree, they may be required to show proficiency in basic industrial and manufacturing engineering subjects such as methods (IME 311) and manufacturing

processes (IME 330). Additionally, students are required to take a minimum of three courses from the following:

- IME 611 Human Factors
- IME 630 Process Engineering
- IME 631 Production Engineering
- IME 640 Engineering Economy
- IME 656 Project Management
- IME 660 Evaluation of Engineering Data
- IME 661 Quality Assurance & Control
- IME 670 Operations Research I
- IME 672 Simulation
- IME 680 Production and Inventory Control

4.2 The Qualifying Exam

All students admitted into the IME Ph.D. Program must pass the qualifying exam (QE). The exam will include a written and oral portions. *Four topics* will be selected by the major professor with consultation with the students. In general, the exam will measure the student's basic knowledge of the fundamentals in core topics related to IME. The written and oral exams will be executed with one day of each other, typically one week before the start of fall semester. Ph.D. students are recommended taking the QE at the end of their first year. Students must notify the IME office in writing of the participation of the coming QE at least two months before the exam.

The following are the candidate topics for the QE. The POS committee will decide the topics that the students will take for the QE written exam. Cross-selection is allowed. For example, a student from Manufacturing Engineering can choose statistics as one of the QE topics.

- Topics for **Industrial Engineering**:
 - a) Operations research
 - b) Probability
 - c) Statistics
 - d) Production/operations management
 - e) System modeling and analysis
 - f) Data analytics
- Topics for **Manufacturing Engineering**:
 - a) Polymer processing
 - b) Manufacturing planning
 - c) Process sequence modeling and design (including simulation)
 - d) Work station design
 - e) Robotics/automation and additive manufacturing
 - f) Manufacturing management (including quality control)
 - g) Biomanufacturing

The *written qualifying exam* will consist of question collected by the major professor and graduate coordinator from faculty that are experts in the selected topics. In general, each exam should be designed to take 90 minutes. The student will take each of the four exams consecutively with a 30 minute break between each of the three exams. In addition, the exams should cover the

fundamental accepts of each topic based on undergraduate classes. Each exam will be graded by the faculty that prepared it. However, the student will not be notified on the outcomes.

The *oral qualifying exam*, which can take up to two hours, allows the student to further elaborate the answers to the questions in the written exam. The committee will consist of the major professor, graduate coordinator and faculty that prepared each exam.

The qualifying exam committee will discuss and determine whether a student passes an exam or not. A student's QE will be considered as a "pass" if and only if all written exams and the oral exam meet the standards of the committee. If a student fails an exam (i.e., any written or the oral exams), then he/she can select to retake the failed portion only once. If the student fails the QE exam twice (no matter the same topic/portion or not), then he/she will be automatically moved to the IME master's program.

4.3 The Comprehensive Proposal

The comprehensive proposal (CP) will be composed of a written proposal and an oral proposal presentation. It must be taken after passing the QE, and there is a minimum period of one semester between the QE and the CP.

The *written proposal* will be a formal proposal with background, literature search, hypothesis, research question and statement of work. The student must submit the proposal to the POS committee four weeks prior to oral presentation.

The first portion of the *oral proposal* presentation will consist of 30-45 minute presentation from the student, detailing their POS and proposal. This portion of the exam is open to the public. The second portion of the oral proposal will consist of the POS committee and student only for a closed-door question and answer. The closed-door portion should last no more than two hours.

The CP is considered as a "pass" if and only if both the written and the oral proposals are satisfactory to the POS committee. If a student fails a proposal, then he/she needs to redo the failed one. If the student fails the same proposal twice, then he/she will be automatically moved to the IME master's program. The POS committee will submit the Report of Preliminary Exam form to the IME office for Graduate School approval within 7 days of the exam.

Upon successful completion of the Dissertation Proposal, the student will formally be admitted to candidacy for the Ph.D. degree.

4.4 Publication

All Ph.D. students are required to submit their research in at least two peer reviewed journals or peer-reviewed technical conferences. The student's major advisor and POS committee will recommend the name or type of journals or conferences in which to publish.

4.5 Dissertation Video

The NDSU Graduate School requires Doctoral students to submit a 3 minute video summarizing their dissertation research for a lay audience. The video requirement must be completed prior to submitting your dissertation to the Graduate School. The disquisition processor will not review

your dissertation until your video has been submitted.

Students will have the option to sign a Dissertation Video Release form which is necessary to allow NDSU to publicly use their video. These videos are stored in NDSU's Libraries Digital Repository. If a student chooses not to sign the release form it will not be uploaded to the Repository, but it will still satisfy the video requirement.

To Schedule Your Video:

- Attend the Required Workshop – 1-2 Semesters prior to filming the video.
- Schedule your Recording Session – before the Final Defense.

More information: www.ndsu.edu/gradschool/graduating_students/dissertation_video/.

Department Requirements

- Ph.D. students must complete the Dissertation Video prior to their Final Defense.
- Students must request a copy of their video and submit it to their advisor for review. The advisor must sign the Checklist in the student's file, indicating that they have reviewed the video and also giving their approval/disapproval of the video's release to NDSU.
 - If the video is approved by the advisor, the student may then choose to sign the Graduate School's Dissertation Video Release form.
 - If the advisor does not approve of the video's release, no further action is required. The video does not have to be approved to fulfill the Graduate School requirement.
 - Students cannot sign the Dissertation Video Release until the Advisor has approved the release of the video to NDSU for public use.
- If the student does not have an approval signature in their file, then the video has not been completed and the Disquisition Approval Page will not be signed by the IME Department Chair.

4.6 Dissertation Defense

All Ph.D. students are required to pass an oral dissertation defense, which is administered by their POS committee, after all coursework and the dissertation have been completed. The Ph.D. dissertation should demonstrate the synthesis of new knowledge that will impact humanity which was independently developed by the student. The defense will be concerned primarily with the dissertation, but it may also cover material from coursework, especially those courses fundamental to the dissertation.

At least *one academic semester* must elapse between the CP and the dissertation defense. Request to Schedule the Final Exam form must be submitted through the IME Office for Graduate School approval at least 2 weeks prior to the date of the exam.

At the conclusion of the final exam, the POS committee will record their decision: pass, conditional pass, or fail, on the student's final exam by submitting the Report of Final Exam to the IME office for Graduate School approval within 7 days of the exam.

A negative vote by any one member of the student's POS committee will signify failure of this exam. Upon permission of a majority of the POS committee members, the student will be allowed to take the exam a second time. The POS committee will specify a period of time, typically not less than one month, which must elapse before the exam can be repeated. An exception to the time limit may be granted by the Dean of the Graduate School upon consultation with the POS committee members.

If both attempts to pass the exam fail, the student may request to take the exam a third time. This request, however, will require the support of the POS committee, IME Graduate Program Coordinator, IME Department Chair and the Dean of the Graduate School.

4.7 Summary of Ph.D. Program

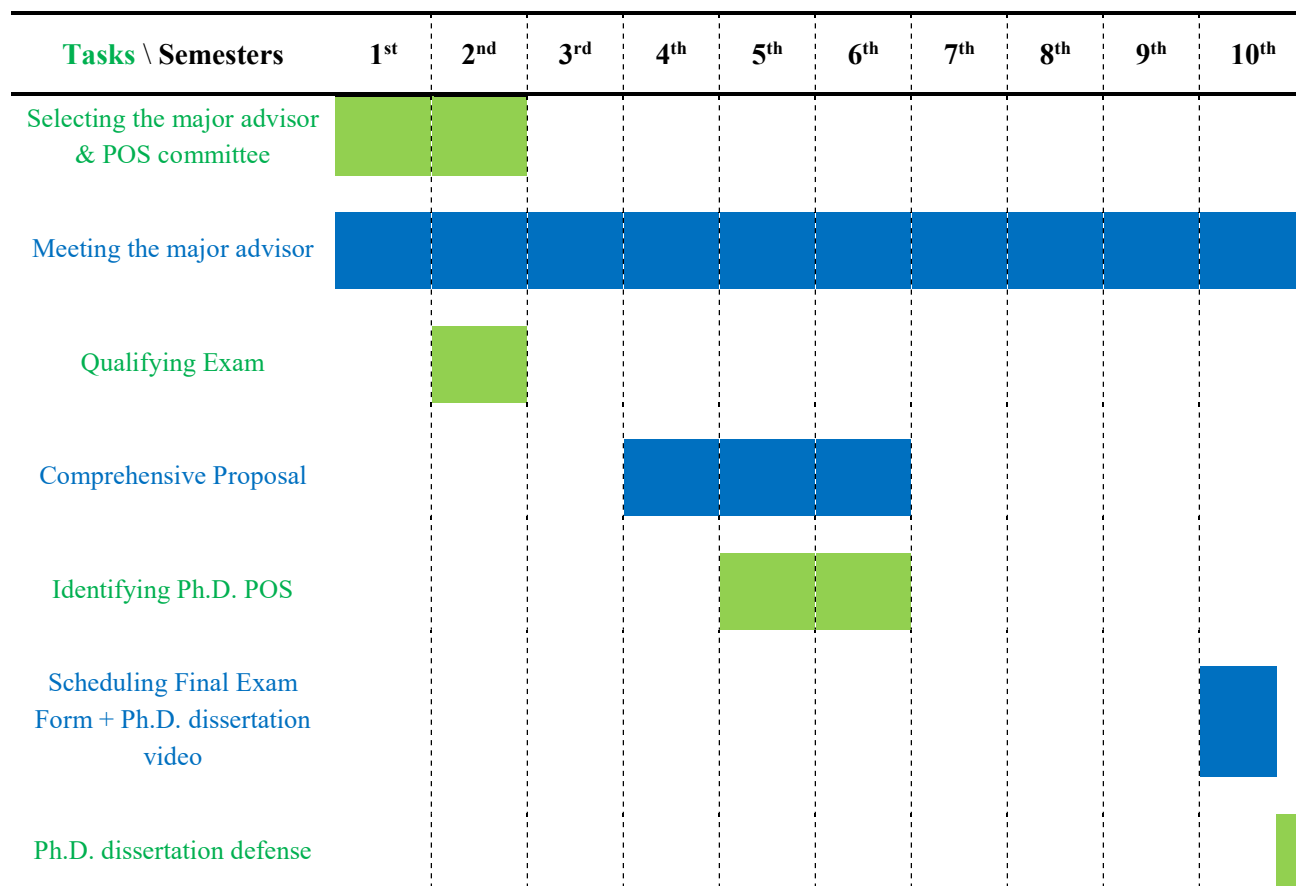


Figure 2 Progress Chart of Ph.D. Program (Based on A Total of Five-years Study)