NDSU
MECHANICAL ENGINEERING

Graduate Program Handbook

Department of Mechanical Engineering
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Introduction

This handbook describes the Mechanical Engineering (ME) Graduate program at North Dakota State University (NDSU). This handbook contains policies and procedures that apply specifically to the NDSU ME Graduate Program and include but are not limited to the policies required by 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 ME 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 projects can be found on the ME Department website.

Non-discrimination Statement

NDSU does not discriminate in its programs and activities on the basis of age, color, gender expression/identity, genetic information, marital status, national origin, participation in lawful off-campus activity, physical or mental disability, pregnancy, public assistance status, race, religion, sex, sexual orientation, spousal relationship to current employee, or veteran status, as applicable. Direct inquiries to Vice Provost, Title IX/ADA Coordinator, Old Main 100, 701-231-7708, ndsu.eoaa@ndsu.edu.

Websites for NDSU Graduate Students

- Admissions Policies
- Code of Academic Responsibility and Conduct
- College of Engineering (COE)
- Department of Mechanical Engineering
- Equal Opportunity and Diversity
- FERPA - Privacy of Records
- Assistantships
- Graduate School forms
- ME Department resources
- NDSU Graduate Catalog
- NDSU Graduate School
- NDSU Graduate Student Handbook
- NDSU One Stop
- NDSU Policies

NDSU Mechanical Engineering Graduate Program

NDSU's ME Department offers three graduate degrees in Mechanical Engineering: 1) Master of Engineering (M.ENGR), 2) Master of Science (M.S.), and 3) Doctor of Philosophy (Ph.D.). Mechanical Engineering is one of six engineering graduate programs in the College of Engineering (CoE). The others are Civil, Construction and Environmental Engineering (CCEE), Industrial and Manufacturing Systems Engineering (IMSE), Electrical and Computer Engineering (ECE), Computer Science (CSci), and Agricultural and Biosystems Engineering (ABEN).

The mission of the ME Department is to:

- Educate undergraduate and graduate students in the fundamentals of the discipline, prepare graduates (B.S., M.ENGR., M.S., or Ph.D.) to effectively function within society in the field of their choice, and provide the learning skills to adapt to evolving personal and professional goals;

- Develop and maintain high quality research programs in traditional and emerging areas that build on the diverse strengths of the faculty, foster interdisciplinary collaborations, and address national and global needs; and

- Serve the needs of the profession, the state of North Dakota, and regional industries, to promote and enhance economic development opportunities.

The goal of the ME Graduate Program is to educate students in the mechanical engineering disciplines in more depth and breadth than at the undergraduate level. The program allows the graduate to utilize contemporary methods at an advanced level to pursue a professional career in engineering design, development, teaching, research and experimentation. Each student's Plan of Study is based on their background and career objectives as well as on sound academic practice. The ME faculty members have teaching and research expertise in areas related to:

- Solid Mechanics
- Creep, Fatigue, Fracture and Failure of Engineering Materials
- Thermal and Fluid Sciences
- Energy
- Materials Engineering
- Composites and Sustainable Materials
- Nanomechanics and Nanomaterials
- Biomechanics, Biomaterials and Biofluidics
- Robotics and Control Systems
- Computational Mechanics

Academic programs emphasizing solid and fluid mechanics, heat transfer, combustion, energy, materials control and mechanical systems, biomechanics and biofluids, nano-materials and nano-mechanics, and computation mechanics may be developed from courses offered by the ME Program. Students desiring a more general program may combine these emphases and may also combine ME Departmental courses with appropriate interdisciplinary courses from other departments in the CoE and NDSU.

1. Admission to the ME Graduate Program

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

- Undergraduate GPA and other activities;
- Graduate Record Examinations (GRE) scores (international students);
- Duolingo, TOEFL, or IELTS scores (international students);
- Area of interest; and
- ME 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. Since admitting a student requires a significant commitment on behalf of the ME faculty, the department believes that it is better to deny admission to a qualified student rather than to admit them and then be unable to offer the support necessary to succeed in graduate school. On the other hand, when a student is admitted, the faculty members in the ME Department are committed to helping them develop the skills needed in the field of mechanical engineering.

1.1. Application Procedure

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

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 (international students), strongly encouraged but not required
- Official results from the Test of English as a Foreign Language (TOEFL), International English Language Testing Systems (IELTS), or Duolingo (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 ME Department for consideration.

1.2. Admission Deadlines

Fall Semester

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

Spring Semester

Application deadline for full consideration of available assistantships	Sept 15
Notification of admission/assistantships	Oct 15
Student response required	Nov 15

University Requirements: Applications from U.S. students must be received 1 month prior to registration. For international students: prior to May 1 for Fall Semester and prior to Aug 1 for spring semester.

1.3. Minimum Admission Requirements

Applications for all programs are expected to have:

- B.S. degree or M.S. degree in engineering, math, physics or a related field from an institution recognized by NDSU; and
- Minimum scores on the TOEFL, IELTS, or Duolingo exams as listed below (for international students)

TOEFL Internet	IELTS	Duolingo[1]	PTE Academic
4 , (71 on tests taken prior to January 21, 2026)	6.0	105	50

Master of Science and Doctor of Philosophy applicants, in addition to the above requirements, are expected to have the following:

- A minimum GPA of 3.0 (on a 4.0 scale) as an undergrad, for admission at full standing; or

[1] *TOEFL/IELTS/Duolingo required for Graduate Teaching Assistantships may exceed those listed, in accordance with the NDSU English Language Proficiency requirements found in the NDSU Graduate Bulletin.*

- 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 300 (Combined Quantitative and Verbal) with a minimum Quantitative score of 155 (for international students) is strongly recommended but not required.

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 may be conditionally admitted if they are supported by a faculty member and satisfy the minimum admission requirements set forth by the NDSU Graduate School.

English Proficiency Requirements

Students who do not meet the English Proficiency requirements for being a Teaching Assistant (TA) at the time of admission can either 1) retake the exam in one of the standardized language tests (i.e., TOEFL, IELTS, or Duolingo) with scores meeting the English Proficiency requirements, or 2) complete the following requirements:

Part 1: Course Enrollment

1. Required: LANG 701 English Lang and Classroom Skills for International GTAs
2. Co-req course (select one): LANG 702, LANG 606, or LANG 704

Part 2: Mock Teaching Exam. The student will arrange a panel of department representatives composed of faculty and students from their department. There must be at least one faculty representative from the English Department. The panel will review and score their teaching presentation.

Upon completion of the above requirements the Coordinator of the Intensive English Program will notify the Graduate School and the department of their results.

Applicants with a Non-ME Bachelor's Degree: Applicants who do not have a degree equivalent to a Bachelor of Science in Mechanical Engineering degree can be admitted into the M. Engr., M.S. or Ph.D. programs, but may be required to complete undergraduate coursework prior to enrolling in graduate courses. Determination of the required coursework will be made by the Graduate Program Coordinator in consultation with the ME Graduate Committee and Department Chair.

Students who do not possess an engineering degree from an ABET accredited institution are encouraged to submit GRE scores for consideration of admission into the graduate program.

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 are some of the forms found on the Graduate School website:

- Masters and Doctoral Plans of Study
- Change to Plan of Study
- Change Supervisory Committee
- Notification of Scheduled Examination
- Report of Preliminary Exam
- Report of Final Defense
- IRB/IACUC/IBC Compliance
- Disquisition Approval Pages
- Add a Certificate to a Degree
- Addition of Graduate Degree
- Degree Objective Change
- Delay Enrollment
- Leave of Absence
- Over 15 Credits Petition
- Reactivation
- Withdraw from Program or Graduate School

Contact Information

Mailing Address:	***Physical Address:***	***Email***:
NDSU Graduate School	NDSU Graduate School	ndsu.grad.school@ndsu.edu
NDSU Dept 2820	106 Putnam Hall	Phone: 701-231-7033
PO Box 6050	1349 12th Ave NW	
Fargo, ND 58108	Fargo, ND 58102	

2. ME Graduate Program Policies

2.1. ME Graduate Program Coordinator

The ME Graduate Program Coordinator (ME-GPC) is responsible for graduate recruitment and admission processes, the graduate curriculum, and to assist students in the academic procedures and policies during their graduate studies at NDSU. Contact information is as follows:

Dr. Yan Zhang
Assoc. Professor and Graduate Program Coordinator
Department of Mechanical Engineering
NDSU Dept 2490
PO BOX 6050
North Dakota State University
Fargo, ND 58108-6050
Email: yan.zhang.4@ndsu.edu

The Graduate Program Coordinator is appointed through an application process by committee. Duties include the following:

- Graduate student recruitment and application processes.
- Promote graduate student opportunities in the ME Department.
- Recruit highly qualified student applications, and maintain records of all graduate student applications for admission.
- Maintain familiarity with university and department requirements for admission and assistantships.
- Work with the ME Graduate Committee to review and revise (as necessary) departmental standards for admission.
- Make recommendations for admission and assistantships to the ME Graduate Committee and Department Chair.
- Respond to inquiries from prospective graduate students.
- Oversee graduate program requirements and curriculum.
- Work with the ME Graduate Committee to make recommendations regarding graduate curriculum changes, course proposals, and etc.
- Monitor progress of graduate students towards degree completion.
- Advise graduate students on course and curriculum requirements.
- Review and approve Plans of Study and other required forms for graduate students.
- Review and approve, as appropriate, the transfer of credit for graduate coursework, provided that all requirements in the ME Graduate Handbook are satisfied.
- Chair the meetings of the ME Graduate Committee.
- Manage assignment of desks, office space and other resources for graduate students.
- Mediate conflicts between graduate students and faculty.

- Act on behalf of the ME Graduate Committee during the summer, seeking other faculty input when appropriate.

2.2. ME Graduate Committee

The ME Graduate Committee consists of the Graduate Program Coordinator (Committee Chair) and other faculty members from the ME 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 ME Faculty concerning the course and curriculum development. Activities include, but are not limited to:

- Development of academic goals, policies, and procedures related to the ME graduate program.
- Administration of graduate academic policies and procedures. (Graduate admissions, approval of Plans of Study, etc.)
- Approval of student petitions for exceptions to ME 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 ME Department will be assigned that faculty member as their advisor. For all other students, the Graduate Program Coordinator 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 second semester of study and must be a full or associate member of the graduate faculty in the ME Department. 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. They will help ensure that the student is making satisfactory progress towards completion of the degree. The major advisor also serves as the thesis/dissertation director and chair of the supervisory 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 choose to share the advising task.

The ME Department realizes that it is sometimes in the best interest of the student to change advisors. For example, a new student may have selected a major advisor, but later wants to accept a Graduate Research Assistant (GRA) position from another faculty member. In such cases, ethical behavior requires that the student consult with their first major advisor before making a commitment to a new advisor.

2.4. Supervisory Committee

The supervisory committee serves to help guide the student as they investigate their research topic and develop their skills in conducting original research. Since the student's major advisor and supervisory committee 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 supervisory committee throughout their graduate studies.

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

- The Major Advisor who chairs the supervisory committee
- A full or associate member of the ME 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 supervisory committee for a Doctoral Candidate must consist of at least **four** members:

- The Major Advisor who chairs the supervisory committee
- A full or associate faculty member of the ME 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 Representative (GSR), who is an NDSU Faculty member from outside the ME Department and is responsible for ensuring policies are followed.

The GSR must be:

- a full member of graduate faculty, AND
- either a tenured faculty member outside the committee chair's/co-chairs' home department OR
- a faculty member outside the primary college of the committee chair/co-chairs.
- If the student is in an interdisciplinary program, the GSR must also be outside of that program.
- Clear of any conflicts of interest with either the student or the committee chair/co-chairs. Examples of possible conflicts of interest may include budgetary relationships, family or financial, personal relationships, or research and/or publication relationships between the GSR and either the student or the committee chair.

The Graduate School Representative should be invited to meetings but is not required to attend. At a minimum, the student must meet with the supervisory 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 supervisory 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 has lost interest in pursuing a graduate degree at NDSU.

Master of Engineering (M. ENGR) students are not required to have a supervisory committee.

Committee Changes

Revisions may be made with the Request for Change form at a later time as advisable but must be approved by the student, advisor, the administrator of the student's program, and the graduate dean.

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 ME Graduate Program Coordinator and then to the NDSU Graduate School through the ME Office.

2.6. Support and Funding

Financial support for graduate students may come from the ME 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 receive a full or partial tuition waiver as well as a salary, 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.

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

Masters of Engineering students are not eligible to receive an assistantship.

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 ME Department has limited support for hiring Graduate Teaching Assistants (GTAs) and Graders. GTAs may be responsible for teaching lower-level courses or laboratories for the department. Graders are responsible for grading homework, quizzes, exams, etc. for individual courses. 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), IELTS, Duolingo and PTE Academic. The minimum test score requirements for GTA and Grader positions are listed below.

GRADER minimum score requirements

	iBT (TOEFL)	IELTS	Duolingo	PTE Academic
Total	4(new) 79 (old)		110	
Speaking Subscale		5.5		51
Writing Subscale		6.0		56

GTA minimum score requirements

	iBT (TOEFL)	IELTS	Duolingo	PTE Academic
Total	4.5 (new) 81 (old)	7.0	115	54
Speaking Subscale	4.5 (new) 23 (old)	6.0	115	62
Writing Subscale	4.5 (new) 21 (old)	6.0	125	56

Students wishing to be considered for a GTA or Grader position must notify the Graduate Program Coordinator at least one semester prior to the start of the hiring term. Most GTA/Grader positions are one-year commitments and are awarded in early March to incoming and returning graduate students. As resources become available, more GTA and Grader positions may become available. The positions are awarded on a competitive basis and the decisions to award them are based upon the students' GRE scores, TOEFL/IELTS/Duolingo scores, GPA, progress made towards graduation and area of expertise.

All graduate students who receive assistantships from the department should successfully take and pass any safety training as well as the sexual harassment training as required by the University. Graduate Students in a Teaching Assistant role will have additional training in Data Privacy and FERPA compliance. NDSU Graduate School withdraws the Tuition Waiver for students who have not completed their training.

ME Assistantship Contracts

The NDSU Graduate School requires a contract be completed for ME graduate students who are being offered a graduate assistantship (GA). Any assistantship contract for GRA or GTA has the compensation, duties, hours, or other significant aspects of the assistantship. The contracts provide clear expectations of responsibilities, establish evaluation procedures, and make explicit the compensations GAs will receive for their work. If there is a change in the terms of the contract during the specified length of the contract, an addendum to the contract should accompany the 101 forms as it is routed to the Graduate School. Changes that require an addendum include a change in hours, a change in compensation, or a change in duties.

Contract templates are available on the NDSU Graduate School website. There are separate templates for research, service, and teaching assistants, the template utilized must correspond with the job code specified on the student's hiring form. The contract should accompany the hiring form as it is routed to the Graduate School by the Business Coordinator.

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 financial aid, students must be enrolled at least half-time (5 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 (5) 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 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. An Over 15 Credits Petition form is required.

Summer Semester

Summer semester credit requirements may vary depending on financial aid eligibility requirements. Students should check with NDSU One Stop to determine the number of credits in which they are eligible to enroll. Likewise, international students should check with their global programs advisor to verify their eligibility requirements.

Tuition waivers may be available for the summer semester if a student worked enough 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 ME 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 the Graduate Program Coordinator or 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 spaces 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 ME office. The student will be expected to complete all necessary safety training and submit all certificates of completion to the ME 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 ME Department's Safety Committee.

2.9. Advising and Registration

Each semester students will meet with their advisor prior to enrolling in the upcoming semester. An Advising HOLD will be put on each student's account in the first semester of enrollment in the program and be removed after meeting with their advisor. Students will not be able to register until this hold has been removed.

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 if minimum enrollments have not been met.

2.10. The Graduate Courses

A list of graduate courses offered by the ME Department can be found in Appendices B and C of this Graduate Handbook. Students might need to register for some 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 ME Department is considered to be an ME Course, regardless of the section in which the student is enrolled.

2.11. ME Department Graduate Series Seminars

To supplement a student's formal coursework and research experience, the ME Department requires enrollment in our seminar course, ME 790: ME Graduate Seminar. M.S. and Ph.D. students are required to enroll in ME 790 **each** semester of their graduate study but not to exceed three semesters, per degree. ME 790 is offered as a one (1) credit, required course and grades will be given only as pass/fail. These credits are in addition to the minimum coursework and research credits required for each degree. This course is offered every fall and spring.

Seminars are scheduled, on average, every other week, with approximately 8 per semester. They may be offered by graduate students, faculty members, visiting researchers or guest speakers. Enrolled students are expected to attend at least two-thirds of the scheduled ME Graduate program seminars to receive a passing grade unless otherwise noted in the course syllabus.

Any student who attends less than the required number of seminars may petition the ME Graduate Committee, in consultation with the student's major advisor, to make up any missed seminars (e.g., by attending seminars offered by other departments).

Each student is required to present one seminar on their research, per graduate degree.

Students in the Accelerated Master's program are only required to register for two (2) semesters of ME 790 and present one seminar.

2.12. Co-op/Internship Work Experience

The ME 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 to allow for making appropriate arrangements as necessary. 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 their 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 mechanical engineering requires a minimum of three years, and more typically four 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. Likewise, 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.

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 of a thesis/paper/dissertation is submitted, the student must re-apply 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 of a thesis/paper/dissertation are submitted to the Graduate School.

2.14. Dismissal from the Graduate Program

The progress of each graduate student will be reviewed by the ME Graduate Program Coordinator, in consultation with the Graduate Committee and 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 ME 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, may be dismissed from the program.

Dismissal Procedure

For any student subject to dismissal, the student's major advisor and supervisory 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 from the decision date.

The student may appeal the decision of dismissal within four weeks of notification by submitting a letter to the ME Graduate Committee.

2.15. Petition to the Graduate Committee

This handbook includes the general policies and procedures for the ME 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 ME graduate Committee to request special consideration.

2.16. Leaving the Department

Students are required to return all keys for the office, laboratories and building; clean up office/lab spaces; and return any department-owned books, solution manuals, computers, or other equipment.

3. Accelerated Master's Program in Mechanical Engineering

This program option allows undergraduate students in mechanical engineering to start on their master degree coursework while completing their BS degree.

3.1 Admission Requirements

- Must have completed 75 credits towards the BS degree in mechanical engineering.
- Must possess a cumulative GPA of at least 3.25.
- Must be admitted into the professional program in mechanical engineering.

Program Requirements

- Admission to the graduate school is conditional with the minimum condition being the completion of the BS degree in Mechanical Engineering.
- No undergraduate courses will satisfy graduate program requirements.
- A maximum of six (6) credits of 600-level or 700-level elective courses can be applied to both the undergraduate and graduate programs in mechanical engineering.
- Students must meet all of the requirements normally expected of a student enrolled in the MS program.
- Graduate courses will be subject to the graduate tuition rate and are not included in the tuition cap.

4. M. Engr Program in Mechanical Engineering

The Master of Engineering (M. Engr.) degree in Mechanical Engineering (ME) is a coursework-only master's degree. To earn the degree, students will be required to complete 30 credits of coursework at the 600 or 700 level, but will not be required to complete a research-based thesis or comprehensive project-based paper. Students pursuing this degree option will be able to enroll in the same courses currently offered by the ME Department for students enrolled in the M.S. options.

Students enrolled in the M. Engr. program will not be eligible to receive a Teaching or Research Assistantship (TA/RA) from the department, nor will they be eligible for a tuition waiver.

Students in the Ph.D. program will not be permitted to switch to the M. Engr program at any time.

Should extenuating circumstances occur that prevent M.S. students from completing their thesis/paper, they may be eligible to transition to the Master of Engineering program. A letter of support from the student's advisor and supervisory committee must be submitted to the graduate program coordinator for review by the ME graduate program committee. If approved, any completed research credit (ME 797/798) will not be applied toward the coursework only degree.

4.1 M. Engr Program Requirements

Course Requirements

- A minimum of 30 course credits from approved graduate courses are required, with a minimum of 24 from didactic courses (601-689 and 700-789). The remaining course credits may come from other approved graduate level courses, such as Individual Study (ME 793), or Special Topics (ME 696/796).
- Of the required course credits, a minimum of 18 credits must come from graduate level ME courses (600-700 level), with a minimum of 9 credits from 700-level ME courses.

5. M.S. Program in Mechanical Engineering

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

- The ME department philosophy and a short description of the M.S. degree program.
- Summary of the roles and responsibilities of the student, their advisor, and their supervisory committee.
- Requirements for the M.S. degree in mechanical engineering.
- List of milestones and requirements a student needs to meet in order to earn an M.S. degree.

The philosophy of the ME Department with the M.S. program is to empower the student, their major advisor and supervisory committee to tailor the student's studies according to their background, skills, interests, and challenges within the student's area of interest.

The milestones and requirements of the M.S. program are described herein, 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 supervisory 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 supervisory 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 do M.S. level research in the student's chosen area.
- The student's supervisory committee members will typically be experts in related areas, which can provide great breadth of knowledge than one person can provide

Together, the student's major advisor and supervisory committee help guide the student towards completion of their 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 they have 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.

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

5.1. M.S. Degree Options in Mechanical Engineering

Two M.S. Degree options are available in the Mechanical Engineering Department:

- *Thesis Option,* which emphasizes research, the ability to analyze data, and preparation of a scholarly thesis.
- *Comprehensive study option,* which emphasizes a broader understanding of the major area.

The main difference between the two options for an M.S. degree is that the final document developed by the student is a *thesis* under the thesis option and it is a *paper* under the comprehensive study option. Only students enrolled in the thesis option are eligible for GTAs or GRAs in the ME department.

A minimum of 30 graduate credits is required for the M.S. degree at NDSU.

5.2. M.S. Thesis Option Requirements

The MS thesis typically documents the student's first exposure to the research process. This document often includes:

- Problem statement (the objective, or hypothesis, of the thesis).
- Explanation of present knowledge related to the problem.
- Presentation of the new knowledge created by the student in meeting this objective, or in testing the hypothesis.

The requirements for how thorough and significant the latter two sections must be are determined by the student's major advisor and supervisory committee. Students who select the thesis option need to work closely with both their major advisor and supervisory committee as they move forward on the research. Significant guidance from the major advisor and supervisory committee is expected since this is often a student's first exposure to the research process.

Course Credits (21-24 credits)

- A minimum of 21 course credits from approved graduate courses is required, with a minimum of 18 from didactic courses (numbered 601-689 and 700-789). The remaining course credits may come from other approved graduate level courses, such as Individual Study (ME 793), Field Experience (ME 795), or Special Topics (ME 696/796).
- Of the required course credits, a minimum of 15 credits must come from graduate level ME courses (600-700 level), with a minimum of 9 credits from 700-level ME courses.
- Of the required didactic courses, at least one must be an advanced mathematics course, The mathematics requirement may be fulfilled by taking ME 711 (Advanced Engineering

Analysis), or another approved graduate level math course offered by another department (i.e., Math or Statistics).

- The courses should be selected in consultation and approval of the major advisor.

M.S. Thesis Credits (6-9 research credits)

- A minimum of 6, but not more than 9, thesis credits (ME 798) may be applied towards the M.S. degree.
    - A typical M.S. thesis in the ME Department requires 6 thesis credits. All graduate students in the Thesis Option are recommended to submit an article to a refereed journal or refereed conference based on their thesis research.
    - To be considered for 9 thesis credits to be applied to the M.S. degree, a student must have one article accepted to a refereed journal based on research work performed at NDSU. The student's major advisor, supervisory committee, and the Graduate Program Coordinator or Department Chair must approve the request for 9 thesis credits.

5.3. 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. At this stage, 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 2–5-page written proposal should be delivered to the supervisory committee at least one week before the oral presentation. The oral presentation must be held no later than one semester prior to the final thesis defense. 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.

5.4. Publication

Students pursuing the Thesis Option are recommended to write and submit a manuscript to a refereed journal, or to a refereed conference (as determined by the student's major advisor and supervisory committee).

5.5. M.S. Comprehensive Study Option:

The M.S paper (non-thesis) requirement is for students who are more interested in understanding existing knowledge, possibly as the foundation for later work in industry. Exact definitions of what sort of research can result from a Master's Paper are determined by the student's major advisor and supervisory committee. Some examples of a paper would be:

- Survey of existing literature in a given area along with an original example demonstrating and contrasting these methods; or
- Development of a new product along with a survey of how it compares with existing devices.

The limited new knowledge developed in the examples above prevents the paper from being a thesis. If, however, the student adds to their work and develops a technique to significantly improve previous methods, the work may be considered an M.S. Thesis. The format for the Master's Paper typically includes the following:

- Problem statement
- Explanation of present knowledge
- Original Example demonstrating or assimilating several existing techniques

Course Credits (27 credits)

- A minimum of 27 course credits from approved graduate courses is required, with a minimum of 21 from didactic courses (601-689 and 700-789). The remaining course credits may come from other approved graduate level courses, such as Individual Study (ME 793), Field Experience (ME 795), or Special Topics (ME 696/796).
- Of the required course credits, a minimum of 18 credits must come from graduate level ME courses (600-700 level), with a minimum of 9 credits from 700-level ME courses.
- Of the required didactic courses, at least one must be an advanced mathematics course. The mathematics requirement may be fulfilled by taking ME 711 (Advanced Engineering Analysis), or another approved graduate level math course offered by another department (i.e., Math or Statistics).
- The courses should be selected in consultation and approval of the major advisor.

Paper Credits (3 credits)

A research paper must be completed as part of the degree requirements. No more than 3 credits of ME 797 (Master's Paper) may be applied to the degree as part of this requirement.

5.6. Paper Preparation Guidelines

The comprehensive paper is expected to provide evidence that the graduate student has a thorough understanding of a subject related to a field of mechanical engineering. Presenting a quality paper assures that the graduate student has potential as a mechanical engineer to produce similar quality scientific research/design reports in their professional career. The Comprehensive paper requirement is satisfied by completion of a written work that the student's supervisory committee certifies as providing:

- A good understanding of a fundamental subject in mechanical engineering.
- Representative outcomes of thorough research work accomplished by others or by the graduate student themselves.
- A thorough literature survey on the subject of the paper.
- Evidence of a systematic research/design approach to the subject of the paper.
- Competent use of the English language, good organization, and thorough editing.

In addition, it is expected that the graduate student writes and submits to the major advisor a draft of the paper during preparation for the final defense. The draft will be critiqued by the advisor. The student should revise and edit the paper before submitting the final version to the supervisory committee. There are no specified page requirements for the paper, but it should be highly polished and complete to meet the foregoing required criteria. The guidelines for the paper should adhere to the same NDSU Graduate School guidelines for thesis preparation.

Exceptions to any of the requirements noted above may be granted only upon approval by the student's major advisor, supervisory committee, and Graduate Program Coordinator or Department Chair.

5.7. M.S. Thesis/M.S. Paper Defense

Each student must present their thesis/paper in an oral defense administered by the student's major advisor and supervisory committee. At least two weeks prior to the defense, the student will submit the final draft of their thesis/paper to their committee. At least seven (7) calendar days prior to the final defense date, the Notification of Scheduled Final Exam form must be approved by the student's advisor and the graduate coordinator and be received by the Graduate School.

The Report of Final Examination form must be submitted within 14 calendar days following the exam.

A negative vote by more than one member of the student's committee will signify failure of the final exam. 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.

5.8. Summary of the M.S. Program

Milestone	Time Frame	Purpose
Select the Major Advisor and Supervisory Committee	First to Second Semester	To graduate in a timely manner and to begin working on the paper/thesis topic as soon as possible.
Meet the Major Advisor	Every Semester	Demonstrates progress towards the M.S. degree. Allow the Supervisory Committee to: ● help develop the student's research and technical skills; ● keep the student 'on track' for graduating in a timely fashion; and ● refine the student's Plan of Study as new courses and new interests arise.
Complete M.S. Plan of Study	Second Semester	A list of courses in which the student needs to enroll in order to be provided with the technical skills needed to conduct graduate level work in the area of interest.
Develop M.S. Thesis Proposal (Thesis Option Only)	Second or Third Semester	Demonstrate the technical skills needed to conduct Master's level research in the area of interest: ● understanding the problem; ● understanding why the problem is significant; ● ability to develop a plan for how to solve the problem; and ● ability to read the technical literature in the proposal's subject area.
Defense of M.S. Thesis Proposal (Thesis Option Only)	At least one term before the final	For the Thesis Option, the student must present their thesis proposal to the supervisory committee at least one semester prior to the final semester
Journal or Conference Manuscript Submission (M.S. Thesis Option Only)	Final Semester	Disseminate the knowledge obtained for the thesis. Students are recommended to submit a manuscript to a peer reviewed journal or technical conference as determined by the major advisor and supervisory committee.
M.S. Thesis/M.S. Paper Defense	Final Semester	The student must demonstrate the use of their skills to follow through on the plan to complete the research. The purpose of the defense is to evaluate whether or not the student (rather than someone else) completed the work being described in the paper/thesis, as well as that the quality of the work is worthy of a Master's level paper/thesis.

6. Ph.D. Program in Mechanical Engineering

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

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

The philosophy of the ME Department with the Ph.D. Program is to empower the student, their major advisor, and supervisory committee to tailor the student's studies according to their 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 supervisory 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 supervisory 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 supervisory 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 supervisory 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 supervisory committee for overseeing the student's progress and, if necessary, terminating the student's studies if the student is not making sufficient progress.

6.1. Ph.D. Degree Options in Mechanical Engineering

A minimum of 60 graduate credits beyond the M.S. degree, or 90 credits beyond the B.S. degree is required for the Ph.D. degree in mechanical engineering. In addition, each student must pass a comprehensive qualifying exam, consisting of a written component and an oral component, before being formally admitted to candidacy for the Ph.D. degree. Once the student's dissertation has been completed, they must pass a final defense, focusing on the dissertation, before being awarded the Ph.D. degree. Specific details of the curriculum requirements and examinations for the Ph.D. degree are included below.

***M.S./Ph.D. Option*:** The course and research (Dissertation) credit requirements listed for the M.S. degree must be completed. A student enrolling in the Ph.D. program directly after obtaining a B.S. degree (i.e., without having an M.S. degree) may elect to first obtain an M.S. degree.

Ph.D. Option: The course credit requirements listed for the M.S. degree must be completed. The remaining 6-9 research credits, normally awarded for the completion of an M.S. thesis, may be replaced by any approved graduate level research or course credits.

6.2. PhD Program Requirements

Course Credits

- A minimum of 24 additional course credits from didactic courses (601-689 and 700-789) must be completed, with a minimum of 15 of these credits from 700 level courses.
- Of the required Ph.D. course credits, a minimum of 15 credits must come from graduate level (600-700 level) ME Courses, with a minimum of 9 credits from 700 level ME courses.
- A minimum of 24 research (Ph.D. dissertation) credits must be completed.
- The remaining 12 credits may consist of any approved graduate level credits, including didactic courses, Individual Study (ME 793), Field Experience (ME 795), Special Topics (ME 696/796), or Ph.D. dissertation credits. (ME 899)

6.3. Qualifying Exam

The objective of the Ph.D. qualifying exam is to ensure the student has sufficient depth and breadth of understanding in the fundamental subjects in mechanical engineering, particularly those related to their specialized area of research. This exam will challenge and qualify the student's readiness to undertake doctoral level work in the areas of mechanical engineering.

The ME Department will administer the qualifying exam for Ph.D. students. The examination consists of a written component (qualifying exam) and an oral component (dissertation proposal), and is to be taken after the greater portion of the coursework has been completed. In the written part of the exam, the student will select three subject areas in

mechanical engineering. The preparatory courses cover the fundamentals of the subjects at the undergraduate to graduate levels.

All students admitted into the ME Ph.D. Program must pass the comprehensive qualifying exam before being formally admitted to candidacy for the Ph.D. degree.

Written Component

The written exams are prepared in the form of questions or problems from fundamental subjects in mechanical engineering, completed as coursework at the undergraduate or graduate levels in mechanical engineering. In consultation with the student's major advisor, the student should select three written exams from the following areas:

- One examination covering mathematics and numerical methods; and
- Two additional exams on subjects selected from the following list. This list may be amended periodically upon approval of the ME faculty.
    - Mechanics of Materials
    - Thermodynamics
    - Fluid Mechanics
    - Mechanical Properties of Materials
    - Heat Transfer
    - Dynamics and Vibrations
    - Robotics and Controls
    - Biomechanics

The ME Department will administer the exams once a semester, typically the last full week in October for the fall semester and the last full week in February for the spring semester. Each exam will be 3 hours in length, and the tests will be administered over a 3-day period (1 exam per day). These exams will be scheduled with the ME Graduate Program Coordinator. All exams will be closed book and closed notes, but a reference list will be provided to all students in advance to assist them in preparing for the exams.

Retakes: If a student fails any one of the three written exams, only that exam must be retaken the following academic semester. If the student fails two or more of the exams, they must retake all three exams the following semester. However, the exam can be retaken earlier at the discretion of the student, their major advisor, and the ME Graduate Program Coordinator.

If both attempts to pass the written component of the qualifying exam fail, the candidate may request to take the examination a third time. This request requires the support of the student's supervisory committee, ME Graduate Program Coordinator, ME Department Chair, and the Dean of the Graduate School.

If a student fails to pass the written component a third time, that student will no longer be eligible to obtain a Ph.D. degree from the ME program and will be asked to withdraw within one year. If the student does not already possess an M.S. degree in Mechanical Engineering,

they will be permitted to complete the requirements for that degree during that one-year period.

The Oral Component: Dissertation Proposal

The dissertation proposal represents the oral component of the preliminary examination. This component is typically taken within one academic semester after the student has passed the written part of the qualifying exam.

This oral exam, which is administered by the student's major advisor and supervisory committee, consists of a presentation and defense of the student's proposal for their dissertation research. It may also cover material from coursework that is fundamental to the dissertation. At least two weeks prior to the exam, the written proposal should be delivered to the supervisory committee. At least seven (7) calendar days prior to the preliminary exam date, the Notification of Scheduled Preliminary Exam form should be approved by the student's advisor, graduate coordinator and on file with the Graduate School. 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 the intended research work 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.
- Preliminary results or speculation on what the results may be.
- Timeline for completion of the work.

At the conclusion of the oral exam, the examining committee will record their approval or disapproval of the student's presentation and defense by submitting the Report of Preliminary Exam form to the ME Office for Graduate School approval within 7 days of the exam.

A negative vote by more than one member of the student's examining committee will signify failure of this exam. Upon permission of a majority of the student's committee, the student will be allowed to take the oral exam a second time. The examining committee will specify a period of time, not less than 1 month that 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 examining committee members.

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

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

6.4. Publication

All Ph.D. students are recommended to submit and publish their dissertation research in peer reviewed journals or peer-reviewed technical conferences. The student's Major Advisor and supervisory committee will recommend the name or type of journals or conferences in which to publish.

6.5. Dissertation Defense

Each student is required to pass an oral final defense, which is administered by their supervisory committee, after all coursework and the dissertation have been completed. This examination 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 preliminary and final exams.

Notification of Scheduled Final Exam form must be submitted through the ME Office for Graduate School approval at least seven (7) calendar days prior to the date of the exam.

At the conclusion of the final exam, the supervisory committee will record their approval or disapproval of the student's final exam by submitting the Report of Final Exam to the ME office for Graduate School approval within 14 calendar days following the exam.

A negative vote by more than one member of the student's supervisory committee will signify failure of this exam. Upon permission of a majority of the supervisory committee members, the student will be allowed to take the exam a second time. The supervisory committee will specify a period of time, not less than 1 month that 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 supervisory 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 supervisory committee, ME Graduate Program Coordinator, ME Department Chair and the Dean of the Graduate School.

6.6. Summary of Ph.D. Program

Milestone	Time Frame	Purpose
Select Major Advisor and Supervisory Committee	First to Second Semester	To graduate in a timely manner and to begin thinking about, and working on, the dissertation topic as soon as possible.
Meet with Supervisory Committee	Each Semester	Demonstrate that progress is being made towards completion of Ph.D. requirements and allow the supervisory committee an opportunity to: ● Help develop the student's research and technical skills; ● Keep the student on track for graduating in a timely fashion; and ● Refine the student's Plan of Study as new courses and new interests arise.
Complete Ph.D. Plan of Study	Second Semester	Identify courses that provide the student with the technical skills needed to conduct Ph.D. level research in a student's area of interest.
PhD Qualifying Exams: Written Part	After Majority of Coursework has been completed	The student demonstrates they have the technical skills necessary to conduct Ph.D. level research in their area of interest.
PhD Qualifying Exam: Oral Part	Typically, one semester after passing the written exam	The student demonstrates the following: ● an understanding of the proposed problem; ● an understanding of why the proposed problem is significant; ● a plan for solving the proposed problem; and ● they have read the technical literature in the area of interest
Publication in Peer Reviewed Journals	Prior to Final Examination	To disseminate the new knowledge developed through the research and to demonstrate that the work is respected by external reviewers.
Defense	Final semester (at least one semester following Dissertation Proposal)	The student is able to use their skills and follow through on the plan to complete the research. This defense is an evaluation by the examining committee to make sure that the student (rather than someone else) completed the work being described in the dissertation, as well as that the quality of the work is worthy of a Ph.D. level dissertation.

Appendix A: ME Graduate Faculty

Faculty Name & Contact Information	Faculty Expertise and Areas of Interest
Long Jiang, Professor & Interim Dept Chair Long.Jiang@ndsu.edu Phone: 231-9512 Office: Dolve 111F	Polymers and polymer composites, Renewable biobased materials, Nanocomposites, Advanced Polymer processing for morphology control and exceptional properties
Fardad Azarmi, Professor Fardad.Azarmi@ndsu.edu Phone: 231-9784 Office: Dolve 111B	Thermal Spray Coatings, Cold Spraying, High Temperature Materials, Computational and Experimental Solid Mechanics, Advanced Manufacturing
Jordi Estevadeordal, Professor Jordi.Estevadeordal@ndsu.edu Phone: 231-9223 Office: Dolve 210	Advanced laser techniques, thermo-fluid and spray diagnostics, 3D Particle Image Velocimetry, phosphorescence, infrared thermography, filtered Rayleigh scattering
Adam Gladen, Assistant Professor Adam.c.Gladen@ndsu.edu Phone: 231-7315 Office: Dolve 101A	Renewable Energy, Solar Thermal Energy, Energy Storage, specifically Thermochemical Energy Storage, Thermodynamics, Solar Thermochemistry, Heat Transfer, Radiative Transfer in Participating Media, Solar Reactor Design
Inbae Jeong, Assistant Professor Inbae.Jeong@ndsu.edu Phone: 231-14937 Office: Dolve 101C	Robotics and Artificial Intelligence
Ghodrat Karami, Professor G.Karami@ndsu.edu Phone: 231-5859 Office: Dolve 208	Multiscale Computational Mechanics, Biomechanics, Composite Micromechanics, Continuum Mechanics, Structural Mechanics
Majura Selekwa, Associate Professor Majura.Selekwa@ndsu.edu Phone: 231-5667 Office: Dolve 101B	Control Systems, Dynamics, Robotics & Mechatronic Systems
Prakash Parthiban Selvakumar, Assistant Professor prakash.selvakumar@ndsu.ed, Phone: 231-7139 Office: Ehly 216	Biomaterials, Regenerative Medicine, Tissue-engineered vascular grafts, Microvasculature, Decellularized Extracellular Matrix, Bioceramics, Cancer and Vascular Biology
Y. Bora Suzen, Associate Professor Bora.Suzen@ndsu.edu Phone: 231-8302 Office: Dolve 102C	Computational Fluid Dynamics, Transition and Turbulence Modeling, Turbomachinery, Active/Adaptive Flow Control, High Performance Parallel Computing

X. Annie Tangpong, Associate Professor Annie.Tangpong@ndsu.edu Phone: 231-8839 Office: Dolve 111C	Vibrations, Dynamics and Friction: Friction-Vibration Interaction; Friction Damping in Rotating Structures; Damping in Nanocomposites and Biomaterials.
Chad Ulven, Distinguished Professor Chad.Ulven@ndsu.edu Phone: 231-5641 Office: Offerdahl Hall 106E	Polymer and Polymer Matrix, Composite (PMC) Materials, PMC, Processing Technologies, Response of PMCs to Dynamic Loading
Jessica Vold, Assistant Professor Jessica.L.Vold@ndsu.edu Phone: 231-5324 Office: Dolve 111D	Additive Manufacturing Materials, Polymer Matrix Composites, Torrefaction of Lignocellulosic Materials, Bio-Based Composite Materials, Mechanical Testing, Material Characterization.
Xinnan Wang, Associate Professor Xinnan.Wang@ndsu.edu Phone: 231-6696 Office: Ehly 214	Synthesis of Nanomaterials, Nanomechanical Characterization, Nanomanipulation; Biomechanics
Yechun Wang, Associate Professor Yechun.Wang@ndsu.edu Phone: 231-6732 Office: Dolve 111E	Microfluidics Biofluid Mechanics, Computational Fluid Dynamics, Numerical Analysis and Characterization of Organic Coatings
Xiangfa Wu, Professor Xiangfa.Wu@ndsu.edu Phone: 231-8836 Office: Dolve 206	Multifunctional Nanofibers and Nanocomposites, Polymer Matrix Composites, Thin Film and Soft Materials; Nanomanufacturing and Process Modeling
Yan Zhang, Assistant Professor & Graduate Program Coordinator Yan.zhang.4@ndsu.edu Phone: 231-9217 Office: Dolve 101E	Experimental Fluid Dynamics, Advanced Flow Diagnostic Techniques, Wind Engineering and Wind Hazard Mitigation, Bio-Fluid Mechanics and Cardiovascular Hemodynamics Modeling

Appendix B: Graduate (700) Level Courses

Course No.	Title	Cr	Catalog Description	Recommended requisite
ME 711	Advanced Engineering Analysis	3	Mathematical analysis and numerical treatment of engineering problems, eigenvalue problems in lumped and distributed parameter systems, advanced mathematics applied to engineering design.	Graduate Standing
ME 712	Advanced Finite Element Analysis	3	Application of finite element methods to problems of plasticity, viscoplasticity, fracture, vibrations, fluids, material and geometric non-linearity, and heat transfer.	ME 477/677
ME 717	Advanced Controls for Mech. Systems	3	Analysis and design of multivariable control systems for robust stabilization and optimal performance of mechanical systems.	ME 475/675
ME 720	Continuum Mechanics	3	Tensor analysis in affine and metric spaces, kinematics of motion, general principles of continuum mechanics, thermodynamics of deformation, and postulates on constitutive laws.	Graduate Standing
ME 721	Advanced Dynamics	3	Newtonian dynamics; dynamics of particles; dynamics of rigid bodies; multi-body dynamics; variational principles; principle of virtual work; d'Alembert's principle; Hamilton's principle; Lagrange's equation of motion; kinematics of rigid bodies.	Graduate Standing
ME 722	Advanced Mechanics of Materials	3	Stress, deformation, failure analysis of deformable bodies and structures under static and dynamic loadings, fundamental concepts and definitions in stress, strain, energy methods, plasticity, fracture fatigue, creep, contact, impact and stability of solid bodies and plate bending problems.	
ME 725	Advanced Mechanics and Failure of Composites	3	Concepts in static, dynamic, impact, and thermal analysis of anisotropic elastic materials. Failure theories, laminated theories, and micromechanics formulations of composites.	

ME 726	Fracture Mechanics	3	Linear elastic fracture mechanics, energy release rate, stress intensity factor, J-integral, elasto-plastic fracture, crack tip plasticity, crack propagation, fracture fatigue, crack growth, fracture tests, fracture in polymers, ceramics and composite materials.	ME 477/677
ME 729	Advanced Vibrations	3	Newton-Euler method; Lagrange's method; frequency response; modal analysis; natural frequencies; mode shapes; eigenvalue problems; Euler-Bernoulli beam theory; Rayleigh beam theory; Timoshenko beam theory; extended operator; Hamilton's Principle; constrained systems.	ME 421/621
ME 731	Mechanical Behavior of Materials	3	Fundamental concepts of elastic, viscoelastic, and plastic deformation of materials; emphasizing atomic and microstructure-mechanical property relationships. Theory of static and dynamic dislocations; fracture, fatigue, and creep as well as strengthening mechanisms in materials.	ME 331
ME 733	Polymer Nanocomposites	3	Fundamental concepts and principles of nanotechnology, nanostructured materials and nanocomposites; polymer nanocomposites processing, property characterization, and relevant modeling	Graduate Standing
ME 734	Smart Materials and Structures	3	Physics, Chemistry, engineering principles and applications of smart materials and structures. This course describes the physics, chemistry, engineering principles and applications of smart materials and structures.	ME 331 and solid state physics class (Phys 401, 402, or 485)
ME 736	Advanced Surface Analysis	3	Topics include: Tribology, introduction to deposition technologies, surface protection mechanisms, surface preparation for deposition, hard coatings, microstructural characterization, materials science, analytical techniques for surface characterization, evaluation of mechanical performance of depositing layers, case studies.	Graduate Standing
ME 751	Advanced Thermodynamics	3	Rigorous treatment of thermodynamic principles. Emphasis on the concept of availability methods as applied to various engineering systems.	

ME 753	Gas Dynamics	3	Fundamental concepts of fluid dynamics and thermodynamics used in the treatment of compressible flow, frictional flows, and flows with heat transfer or energy release.	ME 352
ME 754	Viscous Fluid Flow	3	Fundamental laws of motion of a viscous fluid used in the consideration of laminar boundary layers, transition phenomena, and turbulent boundary layer flows.	ME 352
ME 755	Fluid Mechanics for Bio/Nanotechnology	3	Fundamental principles of fluid dynamics in micro and nano scales and their applications to direct write nanofabrication technologies and fuel cells.	ME 352
ME 761	Advanced Heat Transfer	3	Advanced study of heat conduction in solids. Analytical, graphical, and numerical evaluations of the temperature field. Use of advanced mathematical methods in the solution of boundary value problems.	ME 454
ME 762	Applied Multimode Heat Transfer	3	The course will expand on the heat transfer concepts covered undergraduate heat transfer courses. The focus is on radiative transfer and applying heat transfer principles to complex, multi-mode heat transfer relevant to current engineering problems.	ME 454
ME 763	Advanced Transport Phenomena	3	Advanced topics in combined heat, mass and momentum transport, with applications to energy and biomedical systems.	Graduate standing

Appendix C: Undergraduate/Graduate (400/600) Level Courses

Course No.	Title	Cr	Catalog Description	Recommended requisite
ME 611	Intro to Nuclear Engineering	3	The course will provide the students with understanding of basic concepts of nuclear physics and its applications to nuclear engineering processes; give the students a broad perspective of nuclear energy. By the end of this course students will be able to solve typical problems of nuclear engineering, will be familiar with basic principles of nuclear reactor design, and major issues associated with its safety and certification.	
ME 636	Bio-polymers & Bio-composites	3	Structure/properties/synthesis of biopolymers, biomaterials and engineered biocomposites derived from plant-based materials. An interdisciplinary course designed for graduate students. Introduction to science and engineering of converting biorenewable resources into novel biobased materials and products. Introduction to principles and concepts critical to successful design of polymeric biomaterials, coatings, and biocomposites. Understanding environmental impacts through life cycle analysis	Cross-listed with CHEM 636 and CPM 636
ME 637	Engineering Ceramics	3	Study the crystal and defect structures to determine the electrical and mass transport behaviors in ceramic materials. Investigation on microstructure of ceramic materials and its effect on optical, magnetic, dielectric, and thermo-mechanical properties.	ME 223, ME 331
ME 666	Basic Principles of Unmanned Vehicles	3	This course equips students with basic knowledge of the principles of unmanned ground, air, and underwater vehicles. Students learn engineering principles involved in developing unmanned vehicles, which include locomotion systems, path planning, control, and navigation systems.	
ME 667	Fluid Power Systems Design	3	Fluid dynamics principles and fluid properties are applied to the study of function, performance, and design of system components	ME 222, ME 352

			and systems for power transmission and control purposes.	
ME 668	Introduction to Biomechanics	3	Introduction to the fundamentals of biomechanics including force analysis, mechanics of deformable bodies, stress and strain, transport phenomena, and viscoelasticity, as well as their applications on biomechanics of soft and hard tissues.	ME 223 and ME 352
ME 669	Energy Storage Technology	3	This course will cover the fundamentals of energy storage. It will provide an introduction to the principles of thermal mechanical and electrochemical storage technologies.	ME 351 and ME 454
ME 670	Renewable Energy Technology	3	Introduction to renewable energy technology such as solar photovoltaic systems, solar thermal energy systems, wind turbines, hydroelectric power, geothermal, and biomass.	ME 350 or ME 351
ME 671	Experimental Stress Analysis	3	Review of analysis of stress and strain – basic equations of elasticity. Introduction to ideal requirements of strain measuring devices – mechanical, optical and electrical strain gauges Electrical Resistance Strain Gauges -- Gauge Factor, Types, Gauge materials, Backing Materials, Adhesives, Protective Coatings, Bonding of Strain Gauges, Lead wires and connections, Semiconductor strain gauges Performance of Strain Gauges – Temperature compensation, Transverse sensitivity, Gauge Length, Response, Excitation level, Stability. Strain Gauge Circuits and recording instruments, Strain Gauge Rosettes analysis, Stress Gauge. Photoelasticity methods - behavior of light, plane polarized and circular polariscope, isochromatic and isoclinic fringe patterns for two-dimensional photoelasticity, three-dimensional photoelasticity, model slicing and shear difference method, birefringent coating method. Introduction to brittle coating method and Moire Fringe technique.	ME 443
ME 672	Fatigue and Fracture of Metals	3	This course will provide an overview of the causes and effects of fatigue failure in metals, and present in-depth coverage of common analytical methods for fatigue design and fatigue life prediction. The differing mechanisms	ME 442

			and analytical techniques for fatigue crack initiation, crack propagation, and fracture will be highlighted. Emphasis will be given to techniques used in industry to design against fatigue failure, including testing, analysis, and validation methods.	
ME 673	Engineering with Polymeric Materials	3	This course will introduce basic polymer materials including plastics, rubbers, adhesives; structures, properties, and relationships of polymers; additives; processing technologies, applications and development.	ME 331
ME 674	Mechanics of Composite Materials	3	This course introduces the mechanics of composite materials with emphasis on their properties, processing, and structural applications. Poly mechanics, lamination theory, and failure criteria for composite materials are covered in detail. The course also explores emerging composite technologies and the application of fundamental concepts to structural design.	
ME 675	Automatic Controls	3	Introduction to industrial automatic controls. Theory and applications of pneumatic control, continuous process control, and programmable logic control. Demonstrations and discussion of the current industrial practice.	Math 266
ME 676	Mech-atron ics	3	Design and development of mechatronic systems that require an integrated knowledge of mechanical engineering, electronics, computer science and control theory.	ME 412 or ME 475
ME 677	ME Finite Element Analysis	3	This course introduces the theory and application of the finite element method, with an emphasis on the use of the method. This course is divided into two parts: a discussion of the concepts and theory behind the FE method, and the use and application of the method using the commercial software package ANSYS Workbench. The theory and application will be presented concurrently throughout the semester. Topics will include 2D and 3D stress analysis (Linear and nonlinear), thermal analysis, beam and frame analysis, modeling techniques, and critiquing the results.	ME 423 and ME 213 or ABEN 255

ME 678	Advanced Flow Diagnostics	3	Introduction and review of fundamentals of advanced thermal and fluid measurement techniques for engineering applications including advanced laser and optical diagnostics, high speed imaging, infrared thermography, fiber optics, fluorescence, etc.	ME 352
ME 680	Biofluids	3	Overview of fluid dynamical phenomena in biological systems; flow behavior of fluids in living organisms; application of fluid mechanics to the cardiovascular system and blood circulation.	ME 352
ME 681	Fundamentals of Energy Conversion	3	Introduction to electric power generating systems and their major components such as turbines, boilers, condensers, and cooling towers.	
ME 682	Fuel Cell Science and Engineering	3	Fundamental principles, technologies, and applications of fuel cells, an emerging class of energy storage/conversion devices.	CHEM 121 and ME 351
ME 683	Intro-duction to Computa-tional Fluid Dynamics	3	Introduction to the methods and analysis techniques used in numerical solutions of fluid flow, heat and mass transfer problems of practical engineering interest.	ME 352
ME 684	Aerospace propulsion	3	Theory and principles of air-breathing and rocket engines used in flight systems. Thermodynamic cycle analysis. Analysis of gas turbine and rocket propulsion systems, characteristics, components, and applications.	ME 352
ME 685	Heating, Ventilation and Air Condition-ing	3	Application of the basic fundamentals of thermodynamics, heat transfer, and fluid flow to heating, ventilating, and air conditioning.	ME 454
ME 686	Nano-technology and Nano-materials	3	This course covers principles of nanotechnology, nanomaterials and develops a framework for their understanding. The basic tools of nanotechnology: nanoscale characterization, physics and materials design will be discussed in the context of current technological advances.	
ME 687	Internal Combust-ion Engines	3	Theory and practice of power and propulsion engines utilizing gas as a working substance.	ME 351

			Study of gas turbines, spark, and compression ignition engines.	
ME 688	Intro-duction to Aero-dynamics	3	Introductory aerodynamics, aerodynamic characteristics of airfoils, and other components subjected to inviscid-incompressible flows; dynamics of compressible fluids; shock waves, one-dimensional flow, expansion waves in two-dimensional flow, and compressible flow over aerodynamic bodies.	ME 352
ME 689	Vehicle Dynamics	3	This course covers the fundamental concepts, principles, and methods to be used in design and operation of vehicles, built on knowledge of statics, kinematics, dynamics and machine design.	ME 213

Appendix D: PhD Qualifying Exam Core Subjects Table

PhD Qualifying Exam Subject	Recommended Topics and Content of Exams	Course of reference	Related materials
Mathematics and Advanced Numerical Methods	Mathematical analysis and numerical treatment of engineering problems, eigenvalue problems in lumped and distributed parameter systems, advanced mathematics applied to engineering design.	ME 711	1: Applied Numerical Methods for Engineers and Scientists" by S Rao, © 2002, Prentice Hall. 2: Applied Numerical Methods for Engineers", by Schilling and Harris, 2000, Pacific Grove, CA.
Thermodynamics	Rigorous treatment of thermodynamic principles. Emphasis on the concept of availability methods as applied to various engineering systems.	ME 751	1. Fundamentals of Thermodynamics (6th Edition) by Sonntag, Borgnakke, and Van Wyle 2. Thermodynamics, An Engineering Approach" (5th Edition) by Cengel and Boles. 3:"Modern Compressible Flow with Historical Perspective (2nd Edition, John D. Anderson, Jr.
Heat Transfer	Advanced study of heat conduction in solids. Analytical, graphical, and numerical evaluations of the temperature field. Use of advanced mathematical methods in the solution of boundary value problems.	ME 761 ME 454	1. Fundamentals of Heat and Mass Transfer, Incropera, Dewitt 2006, John Wiley & Sons 2. Heat Transfer, A.F. Mills 1999, Prentice Hall, NJ
Fluid Mechanics	Governing equations of fluid flow, conservation of mass, stream function, conservation of momentum, Newtonian fluid, vorticity, velocity potential, Bernoulli's flow equation, boundary layer theory and similarity solutions, Laminar flows,	ME 754 ME 755 ME 352	1. Fundamentals of Fluid Mechanics," Munson, Young, Okiishi, and Huebsch 2009 (6th Edition), John Wiley & Sons. 2. An introduction to Fluid Dynamics, Batchelor 2000, Cambridge University Press.

	inviscid flow solutions, steady, parallel, viscous flows, turbulent flows, qualitative definition, time averaging, turbulent jets, turbulence modeling, compressible flows, acoustic waves, shock waves.		3. Physicochemical Hydrodynamics, Probstein 2003, John Wiley & Sons, Inc.
Mechanics of Materials	Concepts of stress, strain, and deformation and their transformation procedures. Application of Energy Methods to solid mechanics problems. Thick and thin- walled cylinders. Bending and torsional analysis of beams. Fatigue, fracture and creep analysis of materials. Theories of failure mechanics. Thermoelasticity. Nonlinear and plastic behavior of materials. Introduction to plates and shells. Buckling and stability analysis of columns.	ME 722 ME 223 ME 442	1. "Advanced Mechanics of Materials," Arthur O. Boresi and R.J. Schmidt Wiley, 6th Edition,2003 2. "Advanced Strength and Applied Plasticity," A.C. Ugural and S.K. Fenster, Prentice-Hall, 2003 3. "Mechanics of Materials," F.P. Beer, E.R. Johnson, JT DeWolf and DF Mazurek, Mc-Graw Hill 2012.
Mechanical Properties of Materials	Elastic deformation in materials. Plastic deformation in materials. Imperfections in materials. Geometry of deformation and work-hardening. Solid solution, precipitation, and dispersion strengthening. Material structure-process-property relationships. Fracture; Atomic & microscopic aspects. Fatigue: Atomic & microscopic aspects. Viscoelasticity of polymeric materials. Creep and superplasticity; atomic & microscopic aspects. Composite materials.	ME 731 ME 331	1. "Mechanical Behavior of Materials", M.A. Meyers and K.K. Chawla, Cambridge University Press, 2008. 2. "Mechanical Behavior of Materials", W.F. Hosford, Cambridge University Press, 2005 3. "Mechanical Behavior of Materials", N.E. Dowling, Prentice Hall, 2007 4. "Materials Science and Engineering, 8th Edition" by W.D. Callister & D.G. Rethwisch, John Wiley, 2010 5. "The Science and Engineering of Materials, 5th Edition" by D.R. Askeland & P.P.Phule, Thomson, 2006

Dynamics and Vibrations	Newtonian dynamics; dynamics of particles; dynamics of rigid bodies; multi-body dynamics; variational principles; principle of virtual work; d'Alembert's principle; Hamilton's principle; Lagrangian dynamics; kinematics of rigid bodies; vibration response of discrete systems and continuous systems (2nd order models and 4th order models).	ME 721 ME 729 ME 222 ME 421	1: Advanced Dynamics, Donald Greenwood, Cambridge, 2003. 2: Mechanical Vibration, S.S. Rao, Pearson, 6th edition, 2016. 3. Vector Mechanics for Engineers: Statics and Dynamics, 12th edition, McGraw-Hill, 2019.
Robotics and Controls	Theory and applications of automatic controls. Analysis and design of multivariable control systems for robust stabilization and optimal performance of mechanical systems. Multivariable system state representation; Linear control; Nonlinear control; Phase plane analysis; Stability; Lyapunov Theory; Sliding control; Adaptive control. Perception and path planning in robotics, Feedback control of robotic actuators. Mechatronic System Integration	ME 675 ME 676 ME 717	1: Applied Nonlinear Control, J-J. Slotine and W. Li, Pearson, 1991 2: Nonlinear Systems, H. Khalil, Pearson, 2001 3: A Course in Robust Control Theory: A Convex Approach, G. E. Dullerud and F. Paganini, Springer, 2000 4: Modern Robotics: Mechanics, Planning, and Control," K. M. Lynch and F. C. Park, Cambridge University Press, 2017 5.Introduction to Mechatronic Design, J. E. Carryer; M. Ohline; and T. Kenny, Pearson, 2010.
Bio-mechanics	Fundamental sciences of engineering and human anatomy that form the basis of biomechanics of soft tissue and bone under dynamic conditions. Viscoelastic deformation in biological materials. Concepts of stress, strain and deformation of biological tissue. Human tolerances, trauma scale and mathematical modeling of the human body.	ME 468/686	1: "Accidental Injury, Biomechanics and Prevention," Alan M. Nahum and John Melvin, 1993, Springer-Verlag 2:"Biomechanics-Structures and Systems, a Practical Approach," Edited by A.A. Beiwener, 1992, Oxford University Press, New York 3: "Frontiers in Head and Neck Trauma," Narayan

			Yoganandan, Frank A. Pintar, Sanford J. Larson and Anthony Sances, Jr., 1998, IOS Press Ohmsha

Appendix E: Graduate Program Checklists