

Graduate Handbook

Department of Electrical & Computer Engineering
North Dakota State University

Revision: September 24, 2007

Introduction:

The following document is a guide to help graduate students and their advisors during the student's time here at NDSU. The overall guiding principle is to set up 'rules' which make sense and help the student along. Since it is difficult to make a set of guidelines which apply in all cases, if it makes sense, any rules and guidelines in this document may be modified by a student's advisor and supervisory committee to meet the needs for an individual.

This document is intended to be a useful tool for graduate students and faculty in the ECE department. The goal is to provide

- A single place where you can find various forms related to graduate school, and
- Help pace yourself so that you graduate in a timely manner - ideally 3-4 semesters for a master's degree.

When a student enters the Master's program, he/she should (in addition to taking classes)

- (first semester): Select a major advisor and area of research. Start reading what others have done in the area.
- (second semester): Define what you intend to do for your thesis or paper
- (third semester): Finish your research, and
- (fourth semester): Finish documenting your research (thesis and journal manuscript) and defend your results to your graduate supervisory committee.

To encourage our students to keep on schedule, several milestones are proposed. While your advisor may not require each milestone, we strongly feel that it is in the student's interest to strive to meet or exceed these milestones. Yes, these milestones do add stress to the lives of our graduate students. Advanced degrees do not come easily, however, so a little stress and hard work is not unexpected.

Jake Glower

May 8, 2003

1 General Information

The Department of Electrical & Computer Engineering (ECE) at North Dakota State University (NDSU) offers two graduate degrees in Electrical & Computer Engineering: Master of Science (M.S.) and Doctor of Philosophy (Ph.D.). This handbook only includes the additional policies and procedures that apply specifically to the ECE graduate program. Therefore, students must also refer to the documentation provided by the NDSU Graduate School for the policies and procedures that apply to all graduate students.

1.1 ECE Graduate Studies

Graduate Coordinator

The Graduate Coordinator is responsible for the admissions process as well as helping students with the academic procedures for obtaining a graduate degree in ECE. The Graduate Coordinator may be contacted in room ECE 101 or by postal mail to the following address:

Graduate Studies
Dept. of Electrical & Computer Engineering
North Dakota State University
P.O. Box 5285
Fargo, ND 58105

jacob.glower@ndsu.nodak.edu

Director of Graduate Studies

The Director of Graduate Studies is appointed by the Dept. Head. The duties of the Director include the following:

- Chair the meetings of the ECE Graduate Studies Committee.
- Sign off on all graduate documents in cases where all requirements and policies in the Graduate Handbook are satisfied.
- Approve, at the Director's own discretion, the transfer of credit for coursework in graduate Plans of Study, provided that all requirements and policies in the Graduate Handbook are satisfied.
- Act on behalf of the ECE Graduate Studies Committee during the summer, seeking other faculty input when appropriate.
- Work with the Assoc. Dept. Head to mediate any disputes between graduate students and faculty.

ECE Graduate Studies Committee

The ECE Graduate Studies Committee (GSC) consists of the Director of Graduate Studies (who chairs the committee) appointed by the Dept. Head and other faculty in the ECE department. The primary function of the committee is to deal with recommendations from the technical groups, and with curriculum development and other matters concerning graduate studies that involve the entire department. Activities include, but are not limited to:

- The development of academic goals, policies, and procedures related to the graduate ECE program.
- Administering graduate academic policies and procedures (graduate admissions, approval of Plans of Study, etc.).
- Approval of student petitions for exceptions to ECE graduate policies.
- Continual review of the graduate curriculum, evaluation of the ability to meet the stated goals, and proposal of needed curricular revisions.

1.2 Graduate School

The NDSU Graduate School has a variety of campus-wide policies and procedures that apply to all students enrolled in the graduate program. The following on-line documentation is available from the Graduate School: at http://www.ndsu.edu/gradschool/grad_forms.shtml

- Commencement Participation
- Master's Degree Plan of Study and Selection of Supervisory Committee
- Doctor of Philosophy Plan of Study and Selection of Supervisory Committee
- Request for Change of Plan of Study / Advisor / Supervisory Committee
- Change of Admission
- Request to Schedule Thesis Final Exam
- Application Deadlines
- Graduate Bulletin
- Application for Graduate School Admission

1.3 Code of Academic Integrity

Integrity is expected of every student in all academic work. The guiding principle of academic integrity is that a student's submitted work must be the student's own. In particular, conduct prohibited by the NDSU Code of Academic Integrity consists of all forms of academic dishonesty, including, but not limited to:

- cheating, fabrication, facilitating academic dishonesty, and plagiarism;
- submitting an item of academic work that has previously been submitted without fair citation of the original work or authorization by the faculty member supervising the work;
- modifying any academic work to obtain additional credit in the same class unless approved in advance by the faculty member;
- failure to observe rules of academic integrity established by a faculty member for a particular course; and attempting to commit an act prohibited by this Code.

For example, it is an acceptable practice to work with other students or use on-line resources (such as solutions manuals) to gain understanding and to learn how to solve a type of problem. The actual doing of the problems should be your own work, however. It is not acceptable to have someone else do your work or to copy solutions from an on-line resource. Since this would be copying someone else's work, you *must* document who did the actual work. This may result in you receiving a zero for this assignment since you did not actually do the work yourself. If you do *not* document who did the actual work, you are claiming this work as your own - and may face more severe repercussions.

As a second example, it is acceptable to read several references, develop your own opinions, and summarize what these authors said (with reference to these sources). It is not acceptable to copy part a reference and submit it as your own work since i) you are not demonstrating that you understand the material, ii) all sources are biased. You often need to read several sources and develop your own opinion on what is right (even in engineering), and iii) you are taking credit for someone else's work.

Any attempt to commit an act prohibited by these rules shall be subject to sanctions to the same extent as completed acts.

1.4 Academic Standing

At the time of graduation, a graduate student must have at least a 3.00 GPA. While taking courses towards graduation, graduate students must keep their GPA at or above 3.00.

Should a student's GPA drop below a 3.00, the following will happen:

- **Good Status:** The student's GPA is 3.00 or above. Students in good status are eligible to graduate, eligible for TA, RA and grader support, and are eligible for tuition waivers (pending support). Any semester a student's GPA rises to 3.00 or above, the student's status returns to Good Status regardless of its previous state.
- **Academic Warning:** The first semester the student's GPA drops below a 3.00, the student will be placed on 'Academic Warning.' Academic Warning means that the student should be concerned about their grade point and work especially hard the following semester to bring his/her grade point average above a 3.00. Students on Academic Warning are not eligible to graduate, but are eligible for TA, RA or grader support and are eligible for tuition waivers (pending support).
- **Academic Probation:** The second consecutive semester a student's GPA is below a 3.00, the student will be removed from Academic Warning and placed on Academic Probation. Academic Probation is a warning that the student is very close (one semester away) from removal from the NDSU graduate school. Likewise, that student needs to concentrate on his/her studies to bring their GPA above a 3.00.

Students on Academic Probation are not eligible for TA, RA, or grader support and cannot receive tuition waivers. While on Academic Probation, the student is expected to dedicate full time on their classes and on bringing their GPA above a 3.00.

- **Academic Suspension:** The third consecutive semester a student's GPA is below a 3.00, the student will be moved from Academic Probation to Academic Suspension.

Students on Academic Suspension are no longer eligible to take classes from NDSU, to receive TA, RA, or grader support, or receive a tuition waiver.

1.5 ECE Graduate Program: Departmental Requirements

(1) All graduate students are required to select a major advisor and supervisory committee by the 8th week of their first semester at NDSU. The supervisory committee should consist of

- Your major advisor (chair of your supervisory committee)
- A faculty member who can contribute to your research interests (not necessarily in the ECE department),
- One ECE faculty member selected by the department chair, and
- A representative of the graduate school.

The graduate school representative should be invited to this meeting but is not required to attend (i.e. his/her signature isn't required).

(2) Each semester, all graduate students are required to meet with their supervisory committee. In this meeting, your committee is responsible for assessing your progress to date and to help guide you in your graduate studies.

(3) At the end of each semester, the ECE Graduate Student Evaluation form (attached to the end of this document) must be completed by each graduate student and his/her supervisory committee. Three copies should be made, with one copy going to the student, one to his/her advisor, and one copy to the ECE Graduate Student Coordinator (Dr. Glower).

Failure to meet with your supervisory committee will be interpreted as the student not wishing to continue his/her studies in the ECE department.

In this situation, students who did not meet with their supervisory committee and turn in the ECE Graduate Student Evaluation form will have a hold placed on their registration and may be dropped from subsequent ECE courses.

(4) All graduate students are required to register for and complete the following courses their first semester at NDSU:

- ECE 702: Research Methods (3cr)
- One additional graduate level course from the ECE department (3cr)

Termination from the ECE Graduate Program

Graduate level courses are high-level courses which assume a solid foundation in the student's B.S. degree and hard work at the graduate level. In rare situations, it may become evident that a student is not going to complete their graduate program. In these situations, the department may terminate the student's graduate standing in the ECE department. These situations can include the following:

- Failing to maintain a 3.00 GPA or higher. The first semester a student's GPA falls below 3.00, the student will be placed on academic warning. If the student fails to bring his/her GPA to 3.00 or above the following semester, the student's supervisory committee may decide to terminate that student's enrollment in the ECE graduate program. In rare situations, the committee may elect to place that student on Academic Probation, allowing that student one more semester to bring his/her GPA to 3.00 or above.
- Failing to make adequate progress in his/her graduate studies. Each semester, all students must meet with their supervisory committee. If all three members of this committee feel the student is making unacceptable progress and recommend that the student does not continue with their graduate studies, the student's status as a graduate student in the ECE program will be terminated.

Students may appeal this termination to the dean of the graduate school.

Credit Load:

A full time student is defined as the following:

- 9 Credits: Graduate students with no departmental support (0h/week)
- 6 Credits: Graduate students in quarter time status (10h/week of departmental support)
- 4 Credits: Graduate assistants in half-time status (20h/week of departmental support)

Graduate assistants wishing to register for more than 15 credits in a regular semester shall secure the approval of their academic dean and the Dean of The Graduate School.

1.6 Faculty Advisor

The Graduate Coordinator will be assigned as the initial Faculty Advisor for all incoming graduate students. The initial Faculty Advisor will assist with the admission process, first-semester course selection, and obtaining a regular Faculty Advisor.

All students must obtain a Faculty Advisor by the end of their **first** semester of study. The Faculty Advisor will serve as the student's mentor, will assist the student in preparing the Plan of Study, and will help to ensure that the student is making satisfactory progress toward completion of the degree. For students pursuing the M.S. thesis option or the Ph.D., the Faculty Advisor also serves as the thesis/dissertation director and provides guidance in the selection of a research topic and supervises the research project.

The department realizes that it is sometimes in the best interest of the student to switch advisors. For example, a new student may have selected a Faculty Advisor, but later wants to accept an R.A. position from another

faculty member. In such cases, ethical behavior requires that the student consult with the first Faculty Advisor before making a commitment to the new advisor.

1.7 Petitions to the Graduate Studies Committee

This handbook includes the general policies and procedures for graduate degree programs in ECE. In rare cases, a student may have legitimate reasons for deviating from these general requirements. In such cases, the student may submit a petition to the ECE Graduate Studies Committee to request special consideration. The petition form is included in the General Forms appendix.

1.8 English Proficiency for Teaching Assistants

The duties of graduate teaching assistants in ECE often include direct instructional contact. Therefore, international students whose native language is not English must

- Earn a 600 or better on their TOEFL exam, and
- Must score at least 50 on the Test of Spoken English (TSE/SPEAK) in order to be eligible for a graduate teaching assistantship in ECE.

The TSE/SPEAK exam is offered the **second Tuesday in August, November, and April**. If you would like to be considered for being a TA, please contact the following by August 1st to have your name added to the list of participants in the August TSE exam.

Graduate Coordinator
Department of Electrical and Computer Engineering
North Dakota State University
Fargo, ND 58105

1.9 Cross-Listed Courses

Cross-listed courses are courses that are listed in the course catalogs of more than one department. The “home department” of a cross-listed course is the department by which the course is normally taught. A cross-listed course with an ECE home department is considered to be an ECE course, regardless of the section in which the student is enrolled.

2 Admissions

Admissions to the graduate program in Electrical and Computer Engineering is on a competitive basis. Each year, the ECE department admits approximately 10 to 20 new graduate students into the MS and Ph.D. program (total). Since the department normally receives many more qualified applications than it can accept, admissions standards may be higher than those listed below. In general, admissions is dependent upon the student's

- GRE scores
- Undergraduate experience (school, activities, etc.)
- Area of interest, and
- Our faculty's ability to advise students in that area of interest.

When a student is admitted, the department expects (given some hard work on the student's and his/her advisor's part of course) that the student will graduate. Since bringing in a student at the graduate level requires a significant commitment on behalf of our faculty, the department believes it is better to deny admissions to a qualified student rather than admit him/her and be unable to offer the support necessary to succeed in graduate school. On the other hand, if you are admitted, the faculty in the ECE department are committed to helping you develop your skills in the ECE field.

2.1 Application Procedure

For general information about Graduate College admissions, see the General Admissions Information provided by the Graduate School.

Send the graduate application and official transcripts directly to the Graduate School. In addition, submit the following materials to the ECE Department:

- ECE Application for Graduate Admissions.
- Copy of the Graduate School application form.
- Copies of all transcripts.
- Official report of the Graduate Record Examination (GRE) General Test scores.
- Copy of the TOEFL results for international students.
- "Statement of Purpose" identifying immediate and ultimate degree objectives, technical areas of interest, and career objectives.
- Three letters of recommendation.

The mailing address is

Director, Graduate Studies
Dept. of Electrical & Computer Engineering
North Dakota State University
P.O. Box 5285
Fargo, ND 58105

Note that the Graduate School only processes applications with paid application fees. All of the forms mentioned above are included in the Application Forms appendix of this handbook.

2.2 Deadlines

The deadline for receipt of the application is as follows:

Applications for Spring Semester	Applications are normally not taken for spring semester
Applications for Fall Semester	Postmarked by February 1st

2.3 GRE

The GRE exam is required for all applicants.

2.4 M.S. Minimum Admission Requirements

The minimum admission requirements for the M.S. degree are as follows:

- Bachelor's degree from an institution recognized by NDSU. Students who do not have a degree equivalent to the NDSU Bachelor of Science degree in Electrical Engineering or Computer Engineering may be admitted into the graduate ECE program, but may be required to complete some undergraduate deficiency courses prior to enrolling in graduate courses.
- Students with a Bachelor of Science degree must have a grade-point average at least 3.0/4.0.
- GRE score must total at least 650/800 on the quantitative score .
- Applicants whose native language is not English are required by the Graduate College to submit a minimum TOEFL score of 525 (paper test) or 193 (computer test) for admission. A minimum score of 600 (250 CBT) is required to be eligible for TA support.

note: If the number of qualified applicants exceeds the number of graduate student positions available, the requirements to gain admission may be exceed those listed above

2.5 Ph.D. Minimum Admission Requirements

The minimum admission requirements for the Ph.D. degree are as follows:

- A M.S. degree in electrical and computer engineering or a related field.
- Applicants whose native language is not English are required by the Graduate College to submit a minimum TOEFL score of 525 (193 CBT). See the Graduate Catalog for a discussion of exemptions, and
- Obtaining a GRE score at least 750/800 (quantitative), and
- Satisfying one or more of the following:
 - Earning at least a 3.5/4.0 grade-point average as an undergraduate, or
 - Earning at least a 3.5/4.0 grade-point average over the past 2+ semesters of graduate studies at NDSU, or
 - Earning a Master's degree in Engineering, Math, Physics, Computer Science, or Optics. Students who do not have a degree equivalent to the NDSU Bachelor of Science degree in Electrical Engineering or Computer Engineering may be admitted into the Ph.D. ECE program, but may be required to complete some undergraduate deficiency courses prior to enrolling in graduate courses. See the Graduate Handbook chapter regarding students with a non-ECE bachelor's degree for further details.

note: If the number of qualified applicants exceeds the number of Ph.D. positions available, the requirements to gain admission may be exceed those listed above

3 Master of Science Degree

3.1 Introduction:

This section of the graduate handbook is intended to help M.S. students, their advisors, and their supervisory committees during the student's work on his/her M.S. in the electrical and computer engineering department at NDSU. This section includes

- A short description of what an M.S. in electrical and computer engineering is,
- A short description of the roles and responsibilities of the student, his/her advisor, and his/her supervisory committee, and
- A list of milestones and requirements a student needs to meet to earn his/her MS degree

Philosophy about the Master's program

The philosophy taken by the ECE department with its MS. program is to empower the student's major advisor and supervisory committee. This allows the student, advisor, and supervisory committee to tailor a student's studies at NDSU according to the student's background, skills, interests, and challenges of the student's area of interest.

The milestones and requirements described herein are intended to be minimal in nature (subject to NDSU requirements). It is expected that these will often be expanded by the student's advisor and supervisory committee as need be to assure that the student receives the background he/she will need upon leaving NDSU.

This philosophy makes it imperative that the student works closely with his/her advisor and supervisory committee as soon as possible:

- The student's advisor will typically be the expert in the student's area of interest at NDSU. The student's advisor likewise has the greatest knowledge of what is needed to do master's level research in the student's chosen area.
- The student's supervisory committee are typically experts in related areas, which provides greater breadth than one person can provide.

Together, the student's advisor and supervisory committee serves to help guide the student towards his/her MS. by

- Helping develop the student's technical skills to the point where he/she has the skills necessary to do research at the master's level (for example, helping in developing a plan of study)
- Helping the student learn what is involved with doing original research at the master's level
- Helping in developing the student's research skills, (such as developing a dissertation proposal for the student's qualifying exam)

This philosophy also places the responsibility of watching the student's progress, and if necessary, terminating the student's studies in the master's program if they feel the student is not making sufficient progress.

Part of our mission as faculty at NDSU is to help develop the skills and talents of our students to ready them for their careers. Unfortunately, our admission process is not perfect, and on occasion, we find a student who does not have the skills or interest to pursue Ph.D. level research in electrical and computer engineering. In these situations, it is better to help the student find a place where he/she can succeed rather than keeping the student in our program wasting his/her most productive years.

Meeting with your Advisor and Supervisory Committee:

Since the student's advisor and supervisory committee are empowered to help the student develop the technical and research skills to do master's level research, it is important that the student meets with his/her committee at least once per semester (the graduate school appointee need not attend each meeting but should be invited to do so.). Meeting with one's committee allows the faculty a chance to work with the student, helping to develop the student's research and technical skills, keeping the student on track for graduating in a timely fashion, and refining his/her plan of study as new courses and new interests arise.

Failure to meet with one's supervisory committee and/or advisor at least once per semester may be taken as an indication that the student is not making progress or has lost interest in pursuing a Ph.D. at NDSU.

3.2 Thesis and Comprehensive (Paper) Options

Two options are available for the Master of Science degree: Thesis Option and Comprehensive Option. The main difference between these two options is the final document developed by the student: a *thesis* under the thesis option and a *paper* under the comprehensive option.

M.S. Thesis: A thesis typically documents the student's first exposure to the research process. This document often includes

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

Requirements for how thorough and significant the latter two sections are (respectively) are left up to the student's advisor and supervisory committee. Hence, students under the thesis option need to work with both closely as they progress on their research. Significant guidance from the student's advisor and supervisory committee is expected since this is often a student's first exposure to the research process.

M.S. Paper (Comprehensive Option): An M.S. Paper is often a design-oriented master's project. Typically, this involves the development, completion, and demonstration of a significant project which illustrates the student's grasp of electrical and computer engineering. Exact definitions for what sort of research can result in a Master's Paper is left up to the student's advisor and supervisory committee. Some examples would be

- A survey of existing literature in a given area along with a significant original example demonstrating and contrasting these methods. (The limited new knowledge created keeps this from being a thesis).
- The development of a new platform along with a survey of how this compares with existing devices. (Again, a limited amount of new knowledge keeps this from being a thesis).

These examples fall short of being a thesis due to the limited new knowledge developed in this work. If, however, the student adds to this work and develop a technique to significantly improve previous methods, this work would probably constitute an M.S. Thesis.

The format for a master's paper typically includes:

- A problem statement,
- An explanation of present knowledge,
- Presentation of a significant original design, and
- Demonstrating how this incorporates important features presented in the present knowledge section.

3.3 Degree Requirements - Thesis Option

The thesis option is intended for students who want to study in a specialized area and work closely with a faculty member on a research topic. Students planning to pursue a Ph.D. typically choose this option.

M.S. Diagnostic Exam:

The M.S. Diagnostic Exam is designed to be a tool which helps you and your supervisory committee put together a plan of study. This is a written exam which covers some core areas in the undergraduate electrical and computer engineering curriculum, including the following.

- Calculus and Differential Equations,
- Circuits,
- Electronics,
- Signals and Systems,
- Computer Engineering,
- Electromagnetics.

Students are required to show proficiency (i.e. pass) four of six areas. If a student passes less than four areas, he/she may be required to take some undergraduate courses to bolster their background in at least four areas.

Meeting with your Advisor and Supervisory Committee:

All MS students are required to meet with their supervisory committee each semester (preferably more often). The supervisory committee's mission is to help guide you through the process of doing original research. If you don't meet with them, they can't help you and your education suffers.

Coursework and Plan of Study

- 24 units of coursework subject to the following limitations:
- 16 units of didactic credits (600..689, 700..789)
- ECE 702 Research Methods taken fall semester your first year at NDSU.
- A minimum of 6 units of 700 level ECE courses (excluding ECE 701, 702, or 703) that are not independent study.
- A maximum of 3 units of ECE independent study. Non-ECE independent study is not allowed.
- A maximum of 9 units of non-ECE coursework (must be in Engineering, Math, Physics, Computer Science, or other areas approved by your supervisory committee).

Thesis

- 6 units of thesis (ECE 798).

Final defense

- Must pass an oral defense of the thesis and coursework.

Seminar

- The student should present their work at a seminar - the requirement for this is left up to the student's advisor and supervisory committee. Presumably, this will be at the ECE department's graduate student seminar held each week during the year.

Publication

- Students in the thesis option are required to write and submit a manuscript to a refereed journal or refereed conference (as determined by the student's advisor and supervisory committee). A 1 to 2 page technical summary based upon the student's thesis is also required to be submitted to ECE Press (a yearly summary of research activities in the ECE department at NDSU.)

3.4 Degree Requirements - Comprehensive (Paper) Option

The Paper option is intended for students desiring a broader education.

M.S. Diagnostic Exam:

The M.S. Diagnostic Exam is designed to be a tool which helps you and your supervisory committee put together a plan of study. This is a written exam which covers some core areas in the undergraduate electrical and computer engineering curriculum, including the following.

- Calculus and Differential Equations,
- Circuits,
- Electronics, and
- Signals and Systems
- Computer Engineering,
- Electromagnetics.

Students are required to show proficiency (i.e. pass) four of six areas. If a student passes less than four areas, he/she may be required to take some undergraduate courses to bolster their background in at least four areas.

Meeting with your Advisor and Supervisory Committee:

All MS students are required to meet with their supervisory committee each semester (preferably more often). The supervisory committee's mission is to help guide you through the process of doing original research. If you don't meet with them, they can't help you and your education suffers.

Coursework and Plan of Study

- 27 units of coursework subject to the following limitations:
- 21 units of didactic credits (600..689, 700..789)
- ECE 702 Research Methods taken fall semester your first year at NDSU.
- At minimum of 6 units of 700 level ECE courses (excluding ECE 701, 702, or 703) that are not independent study.
- A maximum of 3 units of ECE independent study. Non-ECE independent study is not allowed.
- A maximum of 9 units of non-ECE coursework (must be in Engineering, Math, Physics, Computer Science, or other areas approved by your supervisory committee).

Paper

- 3 units of Master's Paper (ECE 797).

Final defense

- Must pass an oral defense of the paper and coursework.

Seminar

- Students in the paper option are not required to present their work at the ECE Departmental Seminar, although they are encouraged to do so.

Publication

- Students in the paper option are required to write a 1 to 2 page technical summary based upon the student's paper and submit this to ECE Press (a yearly summary of research activities in the ECE department at NDSU.)

3.5 Selection of Major Advisor

All students must select their Major Advisor by the end of their first semester of graduate studies. The student's Major Advisor is responsible for working with the student to define their plan of study, selection of a thesis topic, and guiding that student as he/she develops their skills at conducting original research.

3.6 Plan of Study and Supervisory Committee

All students must consult with their Faculty Advisor and submit a Plan of Study by the end of the second semester of study. After being completed by the student, and recommended by the Faculty Advisor, the Plan of Study must be submitted to the ECE Graduate Studies Office and the NDSU Graduate School.

In addition, all students must select their Supervisory Committee at this time. The Supervisory Committee consists of 3 to 4 faculty (including the Major Advisor) with backgrounds related to the proposed thesis topic. This committee serves to help guide the student as they investigate their research topic and develop their skills at conducting original research.

3.7 Thesis Proposal (Thesis option only)

The purpose of the thesis proposal is to allow the student to demonstrate that he/she can identify a problem in his/her area of interest and formulate a strategy on how to apply his/her skills in attacking this problem. Note that at this stage, the student is not expected to have any concrete results. Only an understanding of the problem and how one might approach it is expected.

The thesis proposal is both a written and oral presentation for what the student proposes to work on for his/her MS thesis or paper. This research proposal should include

- The objective of the student's work or the hypothesis he/she wishes to investigate
- An explanation of why this topic is significant
- A literature review and an explanation of what others have done in the area,
- An explanation of what method the student proposes to use to attack this problem, and
- Speculation on what the results may be.

This thesis proposal must be presented to the student's advisor and supervisory committee.

3.8 Thesis / Paper Defense

Each student must present their thesis/paper in an oral defense . This defense will be administered by the student's advisor and supervisory committee.

The final draft of the thesis / paper should be submitted to the Faculty Advisor at least two weeks prior to the oral dissertation defense. Upon approval by the Faculty Advisor, and at least two weeks prior to the defense, the student must submit

- A Request to Schedule Examination form to the NDSU Graduate School
- A Thesis Defense Announcement form to the ECE Graduate Coordinator

At least one weeks prior to the defense, the student must submit the final draft of the thesis / paper, after it is has been approved by the Major Advisor, to the Supervisory Committee.

Two or more negative votes will result in failure of the defense. If the committee requires further thesis revisions as a condition of passing the defense, then the Thesis Revision Requirements form must be completed. The thesis/paper defense may be attempted only twice.

3.9 Summary of MS Program:

Milestone	Time Frame	What you are to demonstrate and why
Select your major advisor and supervisory committee	First semester	If you want to graduate in a timely manner, you need to start thinking about and working on your thesis topic as soon as possible.
Meet with advisor	Each Semester	Demonstrate that you are making progress towards your master's degree Allow your supervisory committee a chance to * help to develop the student's research and technical skills, * keep the student on track for graduating in a timely fashion, and * refine his/her plan of study as new courses and new interests arise
M.S. Diagnostic Exam	0 - 8 cr	You have the background necessary to do advanced research in ECE The Diagnostic Exam is a tool which helps identify areas (if any) in electrical and computer engineering where you need some additional background work.
M.S. Plan of Study	0 - 8 cr	A list of courses you plan to take which will give you the technical skills needed to do graduate level work in your area of interest.
M.S. Thesis Proposal (paper + oral) (Thesis option only)	0 - 11 cr	You have the technical skills necessary to do master's level research in your area of interest You understand the problem you propose to work on You understand why it is significant You are able to develop a plan for how to solve this problem You are able to read the technical literature in your area.
Pass your courses	0 - 30 cr	You have the technical skills necessary to do master's level research in your area of interest
Journal or Conference Manuscript (Thesis Option Only)	Last Semester	You are able to disseminate the knowledge you have obtained in your paper or thesis work. This publication is in the form of a technical summary submitted to ECE Press (a yearly summary of research activities in the ECE department). If you are in the thesis option, a manuscript may also be submitted to a peer reviewed journal as determined by your advisor and supervisory committee.
Thesis / Paper Defense	Last semester	You were able to use your skills and follow through on your plan to complete your research. This defense is a check to make sure that you (rather than someone else) did the work you describe in your thesis or dissertation as well as that the quality of the work is worthy of a thesis or dissertation.

4 Ph.D. in Electrical and Computer Engineering

4.1 Introduction:

This section of the graduate handbook is intended to help Ph.D. students, their advisors, and their supervisory committees during the student's work on his/her Ph.D. in the electrical and computer engineering department at NDSU. This section includes

- A short description of what a Ph.D. in electrical and computer engineering is,
- A short description of the roles and responsibilities of the student, his/her advisor, and his/her supervisory committee, and
- A list of milestones and requirements a student needs to meet to earn his/her Ph.D.

Philosophy about the Ph.D. program

The philosophy taken by the ECE department with its Ph.D. program is to empower the student's major advisor and supervisory committee. This allows the student, advisor, and supervisory committee to tailor a student's studies at NDSU according to the student's background, skills, interests, and challenges of the student's area of interest.

The milestones and requirements described herein are intended to be minimal in nature (subject to NDSU requirements). It is expected that these will often be expanded by the student's advisor and supervisory committee as need be to assure that the student receives the background he/she will need upon leaving NDSU.

This philosophy makes it imperative that the student works closely with his/her advisor and supervisory committee as soon as possible:

- The student's advisor will typically be an expert in the student's area of interest. The student's advisor likewise has the greatest knowledge of what is needed to do Ph.D. level research in the student's chosen area.
- The student's supervisory committee are typically experts in related areas, which provides greater breadth than one person can provide.

Together, the student's advisor and supervisory committee serves to help guide the student towards his/her Ph.D. by

- Helping develop the student's technical skills to the point where he/she has the skills necessary to do research at the Ph.D. level (for example, helping in developing a plan of study)
- Helping the student learn what is involved with doing original research at the Ph.D. level
- Helping in developing the student's research skills, (such as developing a dissertation proposal for the student's qualifying exam)

This philosophy also places the responsibility of watching the student's progress, and if necessary, terminating the student's studies in the Ph.D. program if they feel the student is not making sufficient progress.

Part of our mission as faculty at NDSU is to help develop the skills and talents of our students to ready them for their careers. Unfortunately, our admission process is not perfect, and on occasion, we find a student who does not have the skills or interest to pursue Ph.D. level research in electrical and computer engineering. In these situations, it is better to help the student find a place where he/she can succeed rather than keeping the student in our program wasting his/her most productive years.

4.2 Doctor of Philosophy Degree Requirements

This handbook only includes the additional policies and procedures that apply specifically to the ECE graduate program. Therefore, students must also refer to the documentation provided by the NDSU Graduate School for the policies and procedures that apply to all graduate students.

4.3 Major Advisor and Supervisory Committee

Ph.D. students are required to select a major advisor and supervisory committee before completing 9 credits of graduate level course work. Your advisor and supervisory committee are responsible for tailoring your Ph.D. program to your specific needs - and likewise, needs to be formed early on in your graduate studies.

The student's major advisor must be a faculty member of the ECE department. Typically, the student's advisor is an expert in the students area of interest.

The student's supervisory committee must consist of at least four members :

- The student's major advisor (chair of the supervisory committee)
- A second faculty member from the ECE department - typically an expert in a related area,
- A third member who is an expert in a related area. This can be faculty member from the ECE department, another department at NDSU, or with graduate school approval, outside NDSU, and
- A graduate school appointee - a faculty member from NDSU outside of the ECE department.

The graduate school appointee serves as a form of quality control for NDSU. This appointee serves to assure that comparable standards are used across NDSU in each department's Ph.D. program. The student and his/her advisor can suggest someone to the graduate school for this person, but the graduate school reserves the right to select their own candidate.

Meeting with your Advisor and Supervisory Committee:

Since the student's advisor and supervisory committee are empowered to help the student develop the technical and research skills to do Ph.D. level research, it is important that the student meets with his/her committee at least once per semester (the graduate school appointee need not attend each meeting but should be invited to do so.). Meeting with one's committee allows the faculty a chance to work with the student, helping to develop the student's research and technical skills, keeping the student on track for graduating in a timely fashion, and refining his/her plan of study as new courses and new interests arise.

Failure to meet with one's supervisory committee and/or advisor at least once per semester may be taken as an indication that the student is not making progress or has lost interest in pursuing a Ph.D. at NDSU.

4.4 Students Entering with a B.S. degree

Students entering the graduate program in the department of Electrical and Computer Engineering without an M.S. degree (or equivalent) will be entered into the M.S. program. (i.e. a student must earn their master's degree on their way to a Ph.D.) If you are interested in staying on for a Ph.D., it is important that your advisor and supervisory committee know this early on in your studies. This will allow your advisor and supervisory committee to tailor your program towards your Ph.D. Typically, after 1-2 years, you will write up what you have so far and earn your master's degree while working towards your Ph.D. This can be in the form of a:

- Master's Thesis: Presenting the present state of knowledge and new results from your research. Presumably, your first attempt at doing original research will have significant input from your advisor and supervisory committee. This forms the foundation for your dissertation - with the follow on work (where you demonstrate your ability to do independent research) results in your dissertation.

- Master's Paper: Presenting the present state of knowledge relative to your research, along with possibly, an original example or device demonstrating an understanding of this knowledge. This master's paper can then form the foundation for your dissertation.

4.5 Ph.D. Diagnostic Exam

The Ph.D. Diagnostic Exam is used to help your supervisory committee tailor your plan of study to your specific needs and interests. It is expected that most if not all students will pass this exam (again, it is a tool to help your advisor). This exam is a four-hour written exam which covers undergraduate and masters-level course work from the following areas:

- Biomedical Engineering
- Computer Engineering
- Electronics and Circuits
- Power and Machines
- Electromagnetic and Optics
- Signal Processing and Communications, and
- Systems.

In addition, there is a 2 hour oral component of the Ph.D. diagnostic exam. During the oral portion, the student's advisor and committee are able to probe the student's depth and breadth of knowledge for setting up the student's plan of study.

Students wishing to continue on for their Ph.D. must pass this exam to proceed towards their Ph.D. All students have two opportunities to pass this exam. The Diagnostic Exam is offered twice per year, in October and February.

4.6 Course work: Ph.D. Plan of Study

All Ph.D. students must submit a Ph.D. Plan of Study before earning 39 credits of graduate credit beyond their B.S. degree (9 credits beyond their M.S. degree). The Ph.D. Plan of Study is developed with the student's advisor and supervisory committee. The content of the Ph.D. plan of study includes courses from the student's M.S. program (up to 30 credits), and must have 90 credits of graduate level work, including

Required Courses for Ph.D.		# Credits Permitted
Didactic Courses		
600 Level Didactic Courses	600-689,	0 or more
700 Level Didactic Courses	(701, 704-789)	15 or more
Transfer Credits		0 - 12
ECE Independent Study and/or Experimental Courses		690 - 699 790 - 796
Research Methods	ECE 702	3
Teaching Methods	ECE 703 (Hum 702)	3
Dissertation		ECE 799
Total		60 credits beyond your M.S. degree
Note that courses taken towards your M.S. degree can fulfill any of these requirements (except ECE 799). You must have 60 credits beyond your M.S. degree, 90 credits including your M.S. degree.		

In addition, students are required to satisfy a breadth and depth requirement:

- ECE Breadth: At least 12 credits (total) from four of the following areas of ECE:
 - Power and Machines (63x, 73x)
 - Signal Processing and Communications (64x, 74x)
 - Control Systems (66x, 76x)
 - Computer Engineering (67x, 77x)
 - Electronics (62x, 72x), and
 - Electromagnetic (65x, 75x)
 - Biomedical Engineering (68x, 78x)
- Breadth: At least 6 credits from outside ECE.
- Depth: At least 12 credits from the student's area of specialization (some of these credits can come from outside of the ECE department if approved by the student's advisor and supervisory committee)

The student is to work with his/her advisor and supervisory committee to define a plan of study which will provide the student with the technical knowledge he/she will need to do Ph.D. level research in his/her chosen field. Note that each course may be used for only one breadth / depth category. Also note that courses taken towards your M.S. degree can fulfill any of these requirements (except ECE 799). You must have 60 credits beyond your M.S. degree, 90 credits including your M.S. degree.

ECE 701, ECE 702, ECE 703 (Hum 702)

All students (M.S. and Ph.D.) are required to take ECE 702 Research Methods fall semester their first year. ECE 702 is designed to help students learn what is research, what is involved with doing Ph.D. level research,

how to formulate a hypothesis or objective statement, and how to formulate a plan for how to answer this hypothesis or meet this objective.

All Ph.D. students are required to take ECE 703 (Hum 702) Teaching Methods before graduating. **All Ph.D. students who are teaching assistants are required to take ECE 703 (Hum 702) during spring semester their first year.**

ECE 701 Mathematical Methods is no longer required.

Foreign Language Requirement

There is no foreign language requirement for ECE students.

4.7 Comprehensive Exam

The purpose of the comprehensive exam is to allow the student to demonstrate that he/she has the technical skills needed to start Ph.D. level research in his/her field. Students must take all sections of the comprehensive exam during the same semester. This exam must be taken after the bulk of their course work has been completed (typically 3 or fewer courses remain in his/her plan of study) and at least one year prior to defending his/her dissertation.

The comprehensive exam includes

- A written exam covering four graduate-level courses in the student's plan of study. This is a 4 to 8 hour written exam covering four graduate level courses in the student's plan of study, selected in conjunction with the student's advisor. Typically, this exam will consist of four 2-hour exams for each course. All four sections must be completed within one week's time (such as two sections being completed on Tuesday, the remaining two completed on Thursday.)
- A take-home portion, where the student is given several technical papers in his/her area of interest to review - ones which the student has presumably not seen before. Typically, the student is given 1 to 2 weeks to read these papers.
- An oral presentation, where the student
 - Presents and explains the content, concept, and techniques presented in these papers. This allows the student to demonstrate his/her ability to read and understand the technical literature in his/her area, and
 - Answers questions related to the written portion of the comprehensive exam.

The oral presentation is should be limited to 2 hours, with 45 minutes (or less) allocated for the presentation of the papers being reviewed, the remainder for questions and interaction with the student's committee.

4.8 Qualifying Exam (Dissertation Proposal)

The purpose of the qualifying exam is to allow the student to demonstrate that he/she has the technical skills needed to read and understand the technical literature in his/her field and can formulate a research plan. Students must pass the comprehensive exam before taking the qualifying exam. The qualifying exam must be taken one year prior to graduating. (Typically, the comprehensive and qualifying exams are completed during the same semester.)

The qualifying exam consists of a written and oral proposal for his/her Ph.D. research. This research proposal should include

- The objective of the student's work or the hypothesis he/she wishes to investigate
- An explanation of why this topic is significant
- An explanation of what others have done in the area,
- An explanation of what method the student proposes to use to attack this problem, and

- Speculation on what the results may be.

The purpose of the qualifying exam is to allow the student to demonstrate that he/she

- Understands the literature in his/her area,
- Understands the technical challenged in his/her area,
- Has identified a problem in his/her area of interest, and
- Has formulated a strategy on how to apply his/her skills in attacking this problem.

Note that at this stage, the student is not expected to have any concrete results. Only an understanding of the problem and how one might approach it is expected.

Students who pass their qualifying exam advance to Ph.D. candidacy.

4.9 Dissertation Defense

The purpose of the dissertation defense is to allow the student to demonstrate that they have the research skills necessary to do Ph.D. level research - as exemplified by the work done on his/her dissertation.

A final oral defense of the dissertation will be administered by the Supervisory Committee. This defense will concentrate on the student's dissertation - although the related technical content of the student's course work often is included by necessity. A passing mark on the dissertation indicates that the supervisory committee feels that the student

- Has demonstrated that he/she has completed their research, as defined by the hypothesis they are testing or their objective statement, and
- Has demonstrated their ability to do significant original research in his/her area of specialization.

Two or more committee members who fail the student (i.e. feel that at least one of these points was not demonstrated) results in the student failing their defense. Should this happen, the student should address the concerns on his/her committee and reschedule his/her dissertation defense. The dissertation defense may be attempted only twice.

The final draft of the dissertation should be submitted to the Faculty Advisor at least two weeks prior to the oral dissertation defense. Upon approval by the Faculty Advisor, and at least two weeks prior to the defense, the student must submit

- A Request to Schedule Examination form to the NDSU Graduate School
- A Thesis Defense Announcement form to the ECE Graduate Coordinator

At least one weeks prior to the defense, the student must submit the final draft of the dissertation, after it is has been approved by the Major Advisor, to the Supervisory Committee.

4.10 Publications:

All Ph.D. students are required to publish their dissertation in a peer reviewed journal¹. Acceptable journals are left up to the student's advisor and supervisory committee.

¹ A paper being accepted or accepted pending modifications is acceptable for this requirement.

4.11 Summary of Ph.D. Program

Milestone	Time Frame Student enters Ph.D. program with a M.S. degree	What you are to demonstrate and why
Select your major advisor and supervisory committee	First semester	If you want to graduate in a timely manner, you need to start thinking about and working on your thesis topic as soon as possible.
Meet with supervisory committee	Each Semester	Demonstrate that you are making progress towards your Ph.D. Allow your supervisory committee a chance to * help to develop the student's research and technical skills, * keep the student on track for graduating in a timely fashion, and * refine his/her plan of study as new courses and new interests arise
Ph.D. Diagnostic Exam	0 - 9 cr	You have the background necessary to do advanced research in ECE The Diagnostic Exam is a tool which helps identify areas (if any) in electrical and computer engineering where you need some additional background work.
Ph.D. Plan of Study	0 - 9 cr	Make sure that the courses you take over the coming years will give you the technical skills needed to do Ph.D. level research in your area of interest.
Pass your courses	0 - 30 cr	You have the technical skills necessary to do Ph.D. level research in your area of interest
Comprehensive Exam	15 -30 cr (3 or fewer courses left on plan of study)	You have the technical skills necessary to do Ph.D. level research in your area of interest
Qualifying Exam	After passing Comprehensive Exam	You understand the problem you propose to work on You understand why it is significant You are able to develop a plan for how to solve this problem You are able to read the technical literature in your area.
Publication in a peer reviewed journal	before graduation	You are able to disseminate the new knowledge developed in your research and that your work is respected by external reviewers.
Dissertation Defense	Last semester At least 1 year after qualifying exam	You were able to use your skills and follow through on your plan to complete your research. This defense is a check to make sure that you (rather than someone else) did the work you describe in your thesis or dissertation as well as that the quality of the work is worthy of a thesis or dissertation.

5 Students with Non-ECE Bachelor's Degree

Students who do not have a degree equivalent to the NDSU Bachelor of Science degree in Electrical Engineering or Computer Engineering may be admitted into the M.S. or Ph.D. program, but may be required to complete some undergraduate deficiency courses prior to enrolling in graduate courses. Determination of the deficiencies are made with the M.S. or Ph.D. diagnostic exam.

M.S. Diagnostic Exam:

The M.S. Diagnostic Exam is designed to be a tool which helps you and your supervisory committee put together a plan of study. This is a written exam which covers some core areas in the undergraduate electrical and computer engineering curriculum, including the following.

- Calculus and Differential Equations,
- Circuits,
- Electronics, and
- Signals and Systems
- Computer Engineering,
- Electromagnetics.

Students are required to show proficiency (i.e. pass) four of six areas. If a student passes less than four areas, he/she may be required to take some undergraduate courses to bolster their background in at least four areas. Typical courses which can be used are as follows:

- Circuits
 ECE 311 Circuit Analysis II
- Electronics
 ECE 321 Electronics I
- Signals and Systems
 ECE 343 Signals and Systems
 ECE 461 Controls Systems
- Computer Engineering
 ECE 275 Digital Systems
 ECE 376 Embedded Systems
- Electromagnetics
 ECE 351 Applied Electromagnetics

6 Support and Funding:

Support for graduate students can come from the ECE department or through research grants. Any graduate student working 10 or more hours for the department (or any other department) at NDSU may receive a tuition waiver as well as their salary. Due to NDSU regulations, graduate students are not permitted to work more than 20h for the university.²

Three types of support are available: Research Assistantships (RA), Teaching Assistantships (TA), and Graders.

Requirements for Receiving Support:

In order for a student to receive support from the ECE department at NDSU, they must

- Be a US citizen or have a valid F1 visa one week prior to the start of the semester, and
- A social security number one week prior to the start of the semester.

Research Assistants:

Funding for research assistants come through faculty writing proposals to various agencies. As a stipulation of these awards, the faculty member is responsible for seeing that the proposed research is completed in a timely manner and for assuring the quality of the research. Often, graduate students help conduct this research under then name of Research Assistants.

Since research assistants are helping fulfill a contract, the RA is often under more pressure than other types of assistants:

- The RA often needs to put in more hours – especially when project deadlines are approaching, and
- The quality of the work is vital for obtaining future funding.

In return for this work, the RA is often paid a base salary as well as receiving a tuition waiver. More often than not, this research serves as the foundation for the student's thesis and/or dissertation as well as fulfilling the requirements for a research contract as well as providing in-depth knowledge into his/her particular field of research.

Each faculty member is responsible for selecting his/her own research assistants. Often, students start out as a TA or a grader and then switch to an RA once he/she identifies a faculty member for their full-time advisor. Students with outstanding credentials can enter as an RA, however. Prospective students are likewise encouraged to contact faculty in their areas of interest to inquire about RA positions.

Teaching Assistants and Graders:

The ECE department has limited support for hiring teaching assistants and graders. These students are responsible for teaching lower-level courses or laboratories for the department or for grading homework sets. In return, the student receives a salary as well as a tuition waiver if working for 10h or more for the department.

To be eligible for a TA position, the student must have

- A TOEFL score of 600 or more, and
- Pass the English Proficiency exam administered by NDSU.

There is no TOEFL or English proficiency requirement for grader positions.

² NDSU's overhead rate for people working 20 hours or less is 1% while it's 42% for people working more than 20h/week. If a TA or RA takes a second job which puts them over 20h/week, the person paying your salary may be hit with an additional 41% overhead charge. This not knowing what your employees cost makes budgeting very difficult.

Appendix: Forms

**ELECTRICAL and COMPUTER ENGINEERING
GRADUATE STUDENT PROGRESS REPORT**

To be completed each semester by each graduate student and his/her supervisory committee.
Please turn in one copy to the graduate student coordinator (Dr. Glower)

(to be completed by the student)

Date of anticipated graduation: _____

Title or description of research: _____

(a) Progress achieved in the past semester:

(b) Goals and work plans for the next semester:

(to be completed by the student's supervisory committee)

Date of supervisory committee's meeting with the student: _____

Your assessment of the student's progress in his/her coursework and breadth and depth of the student's knowledge:

Your assessment of the student's progress on his/her research or paper:

Supervisory committee's comments and recommendations

Supervisory committee:

	Recommend continuation of graduate studies	
Chair: _____	<input type="checkbox"/> Yes	<input type="checkbox"/> No
_____	<input type="checkbox"/> Yes	<input type="checkbox"/> No
_____	<input type="checkbox"/> Yes	<input type="checkbox"/> No
_____	<input type="checkbox"/> Yes	<input type="checkbox"/> No

Student signature: _____