Department of Electrical and Computer Engineering

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ECE Graduate Handbook

Containing information pertinent to the rules and the requirements for obtaining Master's and Doctoral degrees in the graduate program as established by the Department of Electrical and Computer Engineering

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I. General Information for All ECE Graduate Students

A. Other Sources of Important Information

This handbook provides information that is crucial to ECE graduate students as they proceed toward completing their degree requirements. ***It is expected that all students in the ECE department have read this handbook and are familiar with its contents.***

Information is also available on the ECE Department's Web Page: www.ece.binghamton.edu. For information specific to Graduate Students: Click on "Academic Programs" and then "Graduate Programs"

Another important source of information is the ***Graduate Student Handbook for the Watson School of Engineering and Applied Science*** – it provides details on rules and procedures that are common among the departments within the Watson School. For example, it contains information about full-time status, course registration procedures, grades and academic policies, etc. There is a link to it on the ECE Department web page (*Academic Programs>Graduate Programs*) and it can be found on the Watson School's web page at http://www2.binghamton.edu/watson/advising/graduate/index.html

The rules of the Graduate School can be found in the ***Graduate School Manual***, which can be found at http://www2.binghamton.edu/grad-school/new-and-current-students/graduate-school-manual/index.html. This is where you look for the high-level rules that cover all graduate students: registration, graduation, etc.

B. Graduate Degrees in Electrical and Computer Engineering

The Department of Electrical and Computer Engineering currently offers opportunities leading to the following graduate degrees:

1. The *Master of Science in Electrical & Computer Engineering* (MSECE).

2. The *Master of Engineering* (MEng) with *Specialization in Electrical & Computer Engineering*.

3. The *Doctor of Philosophy* (PhD) in Electrical & Computer Engineering.

Information for students in each of these programs is included below.

C. Graduate Courses in Electrical and Computer Engineering

The Electrical and Computer Engineering (ECE) Department offers a range of graduate courses that cover major areas within the discipline. See the "Tentative Plan of Future Graduate Course Offerings" list (available on the ECE Dept Website) for a current listing of courses and when they are likely to be offered. Note that: (i) a relatively small portion of the total course list is offered each academic semester; (ii) courses are usually offered once a year (either Fall or Spring Semesters), or once every two years either on even or odd years); (iii) courses are offered in accordance with the availability of full-time or adjunct faculty with expertise in the field; (iv) additional courses are offered when there is a perceived need, and the requisite minimum enrollment (typically ten or more students) is satisfied. A small number of graduate courses may be offered during the Summer.

Course Numbering Scheme

Graduate courses at the Master's and PhD level are labeled in the 500s or 600s; those labeled in the 600s are more advanced graduate courses and typically have a 500-level course as a prerequisite. Courses numbered 590 – 599 and 690 – 699 are special courses that are discussed below. To a large degree, the center digit of a course indicates the specialization area in which the course falls (see list of specialization areas below), although there is some overlap between areas.

Graduate Courses Cross-Listed With Undergraduate Courses

Some of the 500 level courses are cross-listed with numbers in the 400s. These cross-listed courses require graduate students to complete additional work beyond that required of the undergraduates. *The following restrictions apply to cross-listed courses*:

- they may not be counted if the student has taken a similar course as an undergraduate;
- they may not be counted after taking a course that has the cross-listed course as a prerequisite.

EngiNet Distance Learning Courses

Although most of the graduate courses are taught as conventional on-campus classes, some are offered through *EngiNet*, where on-campus students meet in a video classroom, which facilitates delivery of these courses to distance learners. A handbook explaining *EngiNet* is available from the *EngiNet* office (800-478-0718 or 607-777-4965).

Transfer Courses

A maximum of two courses taken by a graduate student outside Binghamton University may be accepted as valid transfer courses into the master's programs. Transfer courses require approval by the ECE Graduate Director and the Graduate School. Transfer of courses for PhD students is not applicable since the requirement for the PhD is to complete 24 residency credits at Binghamton University.

D. Special Course Types in the ECE Department

EECE 597 & 697 Independent Study

A graduate course which deserves special mention is the *Independent Study*, labeled as EECE 597 at the Master's level and EECE 697 at the doctoral level. The independent study is a course with variable credit, which is available every semester. The arrangement for an independent study consists of a mutual agreement between a faculty advisor and a student whereby the advisor supervises a study undertaken by the student for the equivalent of 1, 2, or 3 credits. Independent studies of 3 credits are considered the equivalent of a regular graduate course, and are expected to entail an equivalent amount of work. A 3-credit independent study fulfills an elective course in the master's requirements. In some cases, an independent study may be the result of an otherwise canceled regular course (due to lack of enrollment, for instance) being taught by the instructor as an "independent study" to a small number of students. In all cases, registration for an independent study requires filling out special "**Watson School Independent Study Course Registration Form**" form in addition to a "**Independent Study Agreement**" form (available in the Department Office and on the ECE Graduate web site), which describes the independent study and how it will be graded. The necessary approvals must be obtained on both forms.

EECE 598 Masters Project

This variable-credit course, labeled EECE 598, is required of MSECE students who choose the Project option. For project completion, a minimum of 3 credits is required. Other special provisions pertinent to this course are described later in this document.

EECE 599 Research Thesis

This variable-credit course, labeled EECE 599, is required of all Master's students pursuing an MSECE with thesis option. For completion, a minimum of 6 credits is required. The details of the course may be found in the University Bulletin. Other provisions pertinent to this course are described later in this document.

EECE 698 & 699 Dissertation

These variable-credit courses, labeled EECE 698 and EECE 699, are required for research in preparation of the PhD dissertation. Students register for EECE 698 before admission to candidacy and EECE 699 after admission. Further details are given later in this document.

EECE 700 Continuous Registration

This 1-credit course, labeled as EECE 700, is offered Fall and Spring semesters, and is available to graduate students who have otherwise completed their course requirements but need to maintain their matriculated status. ***In the event that such status is not maintained, the student must reapply for admission and adopt the newest degree requirements.***

EECE 701 Practicum for Research and Teaching Assistants

This is a variable-credit course, labeled EECE 701, is open to all funded graduate students involved in research and/or teaching under the supervision of a faculty advisor.

E. Financial Aid

For detailed information regarding financial aid, students should consult the University Bulletin, and visit the Binghamton University web site at http://www2.binghamton.edu/grad-school/prospective-students/funding-graduate-studies/index.html. In addition to University-wide scholarships and fellowships, the Department of Electrical and Computer Engineering also offers a small number of teaching assistantships (TAs) to eligible graduate students. Individual faculty members in the program with available research funds may also offer research project assistantships (RPAs) to students on a highly competitive basis.

Teaching Assistantships

A few teaching assistantships are available for graduate students who qualify for them on a competitive basis. The teaching assistantships typically consist of a stipend along with a tuition waiver. The duties of a teaching assistant may include a combination of laboratory instruction, grading, proctoring, conducting discussion sections, giving tutorials, and other activities as considered appropriate by the instructor of the course to which a TA is assigned. TA positions are awarded after a review of applicants based on the following criteria:

(i) Outstanding undergraduate record
(ii) Binghamton GPA
(iii) GRE score
(iv) Domestic applicants
(v) PhD applicants
(vi) Fit of background to existing research

Note that a TA appointment is not indefinitely renewable; typically, the program will support a master's student with a TA for up to one academic year. In special cases, PhD students may receive a TA award for two academic years. Maintaining a TA appointment requires maintaining an excellent academic record after an award has been made. *It must be noted that as a rule new international students are not considered for TA positions, although a few offers are made to truly exceptional new international students. After an international student has demonstrated their ability during their first semester, receiving a TA appointment in subsequent semesters is more likely.*

Research Assistantships

Note that the Electrical and Computer Engineering Department does not play any role in the RPA selection process. An RPA is selected by an individual faculty member with available funds. To inquire about and apply for an RPA appointment, an applicant must establish individual contact with a faculty member directly. The availability of research project assistantships (RPAs) is dependent on research funds individual faculty may have via research grants and contracts. Since faculty are generally anxious to find talented graduate students to work on research projects, any research funding available to a faculty member is likely to be quickly allocated to a suitable applicant. Promptness is therefore of the essence to ensure success. A potential applicant may first wish to browse the Department's web page; it has much information about general research areas in the department as well as individual faculty research interests. There are videos on our web page that describe many of the professors' research interests. Most faculty have links to their personal web pages with detailed descriptions of their research and publications. Browsing a professor's web page will familiarize a student with the faculty research interests, and enable him/her to decide if there is a match of interest. The student may thereafter correspond (by email or otherwise) with the faculty member directly to inquire if any RPA funding is available. The amount, and terms and conditions for RPA funding are similar to those for TA funding, although the amounts in dollar terms may vary within university guidelines.

The university also has certain tuition scholarships and fellowships for which announcements are made from time to time. Information about these resources may be obtained via the Graduate Admissions Office and the office of the Vice-Provost and Dean of the Graduate School.

F. Advising

Graduate advising within the ECE programs is carried out at the following levels:

(a) For matters pertaining to appropriateness of course structure, interpretation of certain rules (at the Watson and Departmental level), and other structural issues, a student may consult the ECE Graduate Director and/or the Watson School Graduate Coordinator.

(b) For matters pertaining to university rules and policies, a student may consult the Watson Graduate Coordinator, or the University Graduate Office directly.

(c) For matters pertaining to financial aid and scholarships, a student may consult the ECE Department Chair and/or the ECE Graduate Director.

(d) For *all* matters pertaining to graduate research (dissertation, thesis, or project), and associated processes such as selection of coursework and evaluation committees, a student must consult his/her thesis/project advisor. *Note that the thesis/project advisor is the person with whom a student needs to establish a close professional relationship, and interact with frequently.*

G. Graduation Requirements for Degree Completion

Early in the semester in which you are planning to graduate it is essential that you visit the Graduate School's **Degree Completion/Graduation Web Site** at

http://www2.binghamton.edu/grad-school/new-and-current-students/academics/index.html

At that site you will find important information about:

- Degree Completion Deadlines… If you miss these deadlines you can't graduate that semester!
- Commencement Information
- Thesis/Dissertation Preparation & Submission Information… These are the requirements you MUST follow to submit your MS thesis or PhD dissertation
    - An MS Thesis or PhD Dissertation must be submitted to and defended in front of your committee
    - The MS project need only be approved by your advisor.

Timing of MS *Thesis* or *PhD Dissertation* Completion: Please note that you must allow ample time ***BEFORE*** the deadlines posted by the graduate school for submission of your thesis/dissertation in order for: (i) your committee to read it, (ii) the thesis/dissertation defense, and (iii) completion of any revisions requested by your committee. Consult early with your advisor regarding his/her timing requirements.

Timing of MS *Project* Completion: Please note that you must allow ample time ***BEFORE*** the deadlines posted by the graduate school for submission of your Recommendation of Degree form in order for your advisor to read and approve your project report… keep in mind that your advisor may require revisions prior to approving the report.

Completion of a graduate degree requires submission of:

(i) Complete the ***Graduate Application for Degree (GAD)***. Master's degree students must complete this online ***EARLY*** *in the semester in which they plan to graduate* ***(see the Grad School's Deadlines for the date).*** This serves as a declaration of intent to graduate and an application for degree completion. It can be accessed through Grad School's Degree Completion/Graduation Web Site (see above). If a student completes the GAD but fails to graduate, she or he must submit a new GAD during the semester in which they will actually graduate.

(ii) A ***Proposed Course of Study and Graduation Check*** form – only for MS & MEng It is available in .pdf format via a link on the ECE web page under "Graduate Programs". This form, when completed, will indicate the details of the student's coursework and other associated academic requirements which must all be fulfilled before candidacy for the degree can be finalized. For MS students, this form requires the signature from the thesis or project advisor. For MEng students, this form requires the ECE Graduate Director's signature.

(iii) A ***Recommendation For Award of Degree*** form. This is a paper form that is available in the office of the Watson School's Graduate Coordinator. For MS & PhD students, this form requires the signature from the student's advisor and then the ECE Graduate Director's signature. For MEng students, only the ECE Graduate Director's signature is required.

II. Requirements for Masters Degrees

This section provides details on the Masters degree programs and ***details on requirements for degree completion*.**

H. Areas of Specialization for Masters Degrees

The Department of Electrical and Computer Engineering currently has seven areas of specialization, shown in Table 1, where *an **x** in the course number represents any of the digits 0, 1, 2, … 9*.

Students pursuing a specific specialization area should consult with a faculty member in that area for advice on course selection to ensure an effective set of courses to meet the student's professional goals.

Table 1: ECE Degree Areas of Specialization

DSP & Communication	**Computer Engineering**
EECE 52x & 62x	EECE 55x & 65x
EECE 54x & 64x	EECE 570, 573
Control Systems	**Information Assurance**
EECE 51x & 61x	EECE 56x & 66x
EECE 503, 504	EECE 657, 658
	EECE 527
Physical Electronics & Electro-Optics	**Power & Energy**
EECE 501, 504, 505, 508	EECE 502, 503, 504, 508
EECE 53x, EECE 549	
EECE 578	
VLSI	
EECE 501	
EECE 570, 573, 574, 575, 577	

I. Requirements for the MSECE Degree

The University Bulletin at http://bulletin.binghamton.edu/ posts the official current MSECE program requirements. The degree requirements for an individual student are those in effect at the time of the student's matriculation; for these requirements, see the online Bulletin for the year of matriculation. A student who matriculated under older requirements may elect to adopt the requirements that are in affect for the current Bulletin.

The **MS program** prepares students for development-oriented engineering careers and/or continuation onto doctoral studies by providing:

- Increased depth in an area of specialization
- Expanded breadth in supporting areas
- Focused study of recent advances in your area of specialization

The MS program provides a balance of advanced theory and practical engineering knowledge necessary to prepare its graduates for professional practice and/or for continuation into a PhD program. The program culminates with either a thesis or a project report through which students develop their ability to perform independent investigation of recent advances and present the results in a written document. The typical time for completion is 18 – 24 months of full-time study.

MSECE Program

The student must maintain at least a B average in the following plan of study:

- Specialization Courses:
  - 3 courses in a single area of specialization (see list of areas above);
  - Only in very special circumstances can EECE 597 Independent Study be used
- Breadth Courses:
  - For *Thesis Option*: 2 ECE Courses in two areas other than specialization
  - For *Project Option*: 3 ECE Courses in at least two areas other than specialization
- Math Methods Course:
  - EECE 506 Mathematical Methods in EE *or*
  - EECE 507 Mathematical Methods in Computer Engineering, *or*
  - Another approved relevant mathematical methods course.
- Electives: 2 Courses – may be either ECE courses or from other departments
  - Any regular ECE Graduate Course not used above
  - EECE 597 Independent Study (can be used for both electives)
  - Certain Out-of-Department Graduate Courses (see details below):
    - Other Engineering, Math & Science Departments
    - Business School
- Thesis Option *or* Project Option (See Details Below):
  - EECE 599 Research Thesis (6 credits) *and* successful defense of MS Thesis, *or*
  - EECE 598 Project (3 credits) *and* acceptance of MS Project Report

Thesis vs. Project

The ***thesis option*** consists of 6 credits of thesis research culminating in the writing of and oral defense of a thesis. Students pursuing this option are expected to perform research to answer some open question in their chosen area of specialization. *Some* examples of suitable MS thesis research are: (i) improve an existing method and verify the performance gain, (ii) compare and contrast two or more existing methods and determine which is better, (iii) characterize the performance of an existing method under new conditions.

The ***project option*** consists of 3 credits of study culminating in the writing of a project report. Students pursuing this option are expected to demonstrate the application of knowledge drawn from the study of recent literature (papers or advanced books). *Some* examples of suitable MS project work are: (i) take an existing paper, implement its method and test it, (ii) write a critical survey of a few existing papers in a specific area.

Thesis Option

Masters thesis research is supervised by a full-time ECE faculty member (although in some cases, the primary advisor may be a non-ECE faculty; however, this is relatively rare). Non-ECE faculty may

serve as research co-advisors, with a full-time faculty being the other co-advisor. The conduct and completion of the thesis research, and in particular, the defense of the thesis research is supervised by a Thesis Committee, which is chaired by the Thesis Advisor. A Thesis Committee is made up of *at least* three (3) members, including *at least two* (2) full-time ECE faculty. The written thesis is submitted to the committee and is then presented orally during an open seminar; acceptance of the thesis by the committee is required for completion of this degree option. See the Watson School's Graduate Handbook for the requirements on submission of theses. It is required that the thesis acceptable for public disclosure (i.e., made available for University or Department archives, and also be eligible for journal publication); in view of this, thesis work cannot be subject to a non-disclosure agreement.

Project Option

Masters project work is supervised by a full-time ECE faculty member (although in some cases, the primary advisor may be a non-ECE faculty; however, this is relatively rare). Non-ECE faculty may serve as a project co-advisor, with a full-time faculty being the other co-advisor. The written project report is submitted for acceptance to the project advisor(s). It is required that the project report be acceptable for public disclosure (i.e., made available for University or Department archives, and also be eligible for journal publication). In view of this, project work cannot be subject to a non-disclosure agreement.

Full-Time Status

An MS student who has completed fewer than 24 graduate credits* at Binghamton ***must enroll for 12 graduate credits to maintain full-time status***. Once an MS student has completed at least 24 credits graduate credits* at Binghamton, then they need only enroll in 9 graduate credits to maintain full-time status. However, once an MS student has completed all their course work and will *only* be registering for thesis or project credits, then they can be certified for full-time status despite registering for fewer than 9 credits. The form for **full-time certification** can be found at http://www2.binghamton.edu/grad-school/new-and-current-students/forms-and-publications/; **please note that there is one form for funded students and one form for non-funded students**.

* Only courses that have been ***completed*** count towards this 24 credits – grades of Incomplete (I), Failure (F), and Unsatisfactory (U) do not count towards this 24 credits.

Continuous Registration

All students who have been admitted into a degree-granting program must maintain continuous registration each semester for a minimum of 1 credit hour of EECE700. Students who do not maintain registration are severed and may not return unless they reapply for admission, paying a new application fee. Students who are readmitted are required to register and pay for one credit for each semester they have not registered, plus one credit for the semester they re-enter, up to a maximum of four credits. Graduate students are not required to maintain matriculation during the summer unless they intend to complete their final degree requirements during this period. However, students graduating in the summer must be registered for at least 1 credit in one (=any) summer session.

Full-Time Status & Immigration Rules

Immigration rules require that international students maintain full-time status. Please be aware that if an international student withdraws from a course without replacing those credits with some other course then they risk being in violation of immigration rules. If that occurs, please *immediately* see the Office of International Student & Scholar Services http://isss.binghamton.edu/ for help in these matters. In some situations there are means to allow international students to register for less that the standard full-time load – for details see http://isss.binghamton.edu/imm/lesscourse.htm. One important situation is during the final semester of study - see "**Completion of Course of Study**" section at

http://isss.binghamton.edu/imm/lesscourse.htm.

Typical MSECE Course Plan of Study

A typical new full-time MS student will register for 12 credits in each of their first two semesters (see section on Full-Time Status). Keep in mind that not all courses are offered each year (and most are only offered in either Fall or Spring but not both). Thus, careful planning is required to ensure requirements can be met in a timely manner. To aid the student in this planning a "Tentative Plan of Future Graduate Course Offerings" is posted in the Graduate Programs section of the ECE Department web page. It is advisable to take courses in the selected area of specialization early in the course of study so that they can support subsequent thesis/project work. It is also advisable to take breadth course and the ECE math course early in your studies. Leaving Electives and thesis/project till the end allows students maximum flexibility in meeting all degree requirements in a timely fashion.

***Typical MSECE-Thesis Plan for EE Areas* (Based on Fall start)**

Fall Year #1	Spring Year #1	Summer	Fall Year #2
3 cr Specialization	3 cr Specialization	3 cr Thesis*	3 cr Thesis
3 cr Specialization	3 cr Breadth Course		Full-Time Certification
3 cr EECE506	3 cr Elective		
3 cr Breadth Course	3 cr Elective		

***Typical MSECE-Thesis Plan for CoE Areas* (Based on Fall start)**

Fall Year #1	Spring Year #1	Summer	Fall Year #2
3 cr Specialization	3 cr Specialization	3 cr Thesis*	3 cr Thesis
3 cr Specialization	3 cr EECE507		Full-Time Certification
3 cr Breadth Course	3 cr Elective		
3 cr Breadth Course	3 cr Elective		

* If thesis work is not done in the summer then there are two options: (i) take 3 credits of thesis in Fall Y2 and another 3 cr of thesis in Spring Y2, or (ii) take 6 credits of thesis in Fall Y2 (although this is not recommended).

***Typical MSECE-Project Plan for EE Areas* (Based on Fall start)**

Fall Year #1	Spring Year #1	Summer	Fall Year #2
3 cr Specialization	3 cr Specialization	3 cr Elective*	3 cr Project
3 cr Specialization	3 cr Breadth Course		Full-Time Certification
3 cr EECE506	3 cr Breadth Course		
3 cr Breadth Course	3 cr Elective		

***Typical MSECE-Project Plan for CoE Areas* (Based on Fall start)**

Fall Year #1	Spring Year #1	Summer	Fall Year #2
3 cr Specialization	3 cr Specialization	3 cr Elective*	3 cr Project
3 cr Specialization	3 cr EECE507		Full-Time Certification
3 cr Breadth Course	3 cr Breadth Course		
3 cr Breadth Course	3 cr Elective		

* Electives taken in summer are typically Independent Studies. If an elective is not taken in the summer then it would need to be taken in Fall Y2 and the full-time certification form would not be applicable (must be taking *only* thesis/project). However, there is a form to allow **international students** to do this: see "**Completion of Course of Study**" section at http://isss.binghamton.edu/imm/lesscourse.htm.

A Special Note for Part-Time BAE MSECE Students

For BAE students who completed EECE 592 and EECE 593 (ELDP 1 and 2) the courses are fit into the MSECE degree requirements as follows:

(a) Ordinarily EECE 592 counts as two Electives Courses and EECE 593 fulfils a Breadth Course requirement;

(b) If one or more of the ELDP courses is/are deemed to be in the student's Specialization Area, point this out to the ECE Graduate Director, and provide the necessary evidence so the course can be counted in the Specialization Area;

(c) A full-time ECE faculty member must either serve as the Thesis/Project Advisor for the student, or for a work-related thesis, a full-time ECE faculty must serve as a co-adviser with a non-faculty member at the industry serving as the other co-advisor. The faculty member ensures that the thesis meets the expected rigor for the thesis whereas the industry co-adviser assures the work is the student's contribution, and does the day-to-day advising.

(d) It is required that the thesis or project report be acceptable for public disclosure (i.e., made available for University or Department archives, and also be eligible for journal publication). In view of this, thesis/project work cannot be subject to a non-disclosure agreement.

J. Requirements for MEng Degrees

The University Bulletin at http://bulletin.binghamton.edu/ posts the official current MEng program requirements for the ECE department. The degree requirements for an individual student are those in effect at the time of the student's matriculation; for these requirements, see the online Bulletin for the year of matriculation. A student who matriculated under older requirements may elect to adopt the requirements that are in affect for the current Bulletin.

The **MEng ECE program** prepares students for careers in professional practice through a flexible combination of:

- Broad study in several technical areas
- Studies in various business-related areas (if desired)

The MEng program is a 10-course-only program that requires no thesis or project. It can be completed in 12 months of full-time study. This makes it especially well-suited to students who seek to enhance their job marketability by extending their skills beyond the BS degree. The flexibility in the MEng program makes it especially well-suited to part-time students.

MEng w/ Spec in ECE Program

The student must maintain at least a B average in the following plan of study:

- EECE Courses:
  - 6 EECE courses; with 3 from each of two areas of specialization (see list of areas above);
  - Only in very special circumstances can EECE 597 Independent Study be used
- Electives: 4 Courses – may be either ECE courses or from other departments
  - Any regular ECE Graduate Course not used above
  - EECE 597 Independent Study (only two can be counted)
  - Certain Out-of-Department Graduate Courses (see details below):

- Other Engineering, Math & Science Departments
- Business School

Full-Time Status

An MEng student who has completed fewer than 24 graduate credits* at Binghamton ***must enroll for 12 graduate credits to maintain full-time status***. Once an MEng student has completed at least 24 credits graduate credits* at Binghamton, then they need only enroll in 9 graduate credits to maintain full-time status. MEng students may not use the form for **full-time certification** because that form is applicable only when taking *only* thesis/project credits.

* Only courses that have been ***completed*** count towards this 24 credits – grades of Incomplete (I), Failure (F), and Unsatisfactory (U) do not count towards this 24 credits.

Continuous Registration

All students who have been admitted into a degree-granting program must maintain continuous registration each semester for a minimum of 1 credit hour of EECE700. Students who do not maintain registration are severed and may not return unless they reapply for admission, paying a new application fee. Students who are readmitted are required to register and pay for one credit for each semester they have not registered, plus one credit for the semester they re-enter, up to a maximum of four credits. Graduate students are not required to maintain matriculation during the summer unless they intend to complete their final degree requirements during this period. But students graduating in the summer must be registered for at least 1 credit in one (=any) summer session.

Full-Time Status & Immigration Rules

Immigration rules require that international students maintain full-time status. Please be aware that if an international student withdraws from a course without replacing those credits with some other course then they risk being in violation of immigration rules. If that occurs, please *immediately* see the Office of International Student & Scholar Services http://isss.binghamton.edu/ for help in these matters. In some situations there are means to allow international students to register for less that the standard full-time load – for details see http://isss.binghamton.edu/imm/lesscourse.htm.

Typical MEng Course Plan of Study

A typical new full-time MEng student will register for 12 credits in each of their first two semesters (see section on Full-Time Status). Having completed 24 credits, the typical MEng student would then require only 9 credits in their 3rd semester to be full time; however, only 6 credits remain for degree completion. Keep in mind that not all courses are offered each year (and most are only offered in either Fall or Spring but not both). Thus, careful planning is required to ensure requirements can be met in a timely manner. To aid the student in this planning a "Tentative Plan of Future Graduate Course Offerings" is posted in the Graduate Programs section of the ECE Department web page. It is advisable to take courses in the selected areas of specialization early in the course of study. Leaving electives till the end allows students maximum flexibility in meeting all degree requirements in a timely fashion.

Typical MEng Plan **(Based on Fall start)**

Fall Year #1	Spring Year #1	Summer
3 cr Spec. Area A	3 cr Spec. Area A	3 cr Elective*
3 cr Spec. Area A	3 cr Spec. Area B	3 cr Elective*
3 cr Spec. Area B	3 cr Elective	
3 cr Spec. Area B	3 cr Elective	

* Electives taken in summer are typically Independent Studies. If two electives are not taken in the summer then 1 – 2 Electives would need to be taken in Fall Y2 and the full-time certification form would not be applicable (must be taking *only* thesis/project). However, there is a form to allow **international students** to do this: see "**Completion of Course of Study**" section at http://isss.binghamton.edu/imm/lesscourse.htm.

A Special Note for Part-Time BAE MEng Students

For BAE students who completed EECE 592 and EECE 593 (ELDP 1 and 2) the courses are fit into the MEng degree requirements as follows:

(a) Ordinarily EECE 592 counts as two Electives Courses and EECE 593 counts as a third Elective Course;

(b) If one or more of the ELDP courses is/are deemed to be in the student's Specialization Areas, point this out to the ECE Graduate Director, and provide the necessary evidence so the course can be counted in the Specialization Area;

K. Out-of-Department Electives for MS & MEng Degrees

Certain regular courses from outside the ECE department are allowable electives; non-ECEE courses in the range 590-599 and 690-699 are not allowed as ECE electives. Registration in non-ECE courses may be subject to requirements and/or restrictions of the offering department and the ECE department can not ensure that an ECE student will be able to register in these courses – address such registration questions to the offering department. If a non-EECE graduate course has a reasonably equivalent EECE course, then the out-of-department course is not allowed as an ECE elective; see the pre-approved acceptable courses listed below.

The following is a list of non-ECE graduate courses that are acceptable as electives:

Bioengineering:
- All courses except those numbered 590 – 599 and 690 – 699.

Computer Science:
- The following courses are NOT allowed: CS514, CS515, CS522, CS524, CS528, CS558, CS622, CS624, and those numbered 590 – 599 and 690 – 699.
- All other courses are allowed and the following are recommended: CS527, CS529, CS532, CS535, CS552, CS553, CS554, CS557, CS565

Materials Engineering: All courses except those numbered 590 – 599 and 690 – 699.

Mechanical Engineering: All courses except those numbered 590 – 599 and 690 – 699.

System Science: All courses except those numbered 590 – 599 and 690 – 699.

School of Management: MGMT501 – MGMT508, MGMT 530, MGMT560, MIS523, MIS533, MIS586, MIS573

Graduate School: In the past the Graduate School has offered the following two courses (during summer & winter terms) that are acceptable (and encouraged) as electives:
- GRD530 Tools for Research & Scholars
- GRD593 Critical Skills for Graduate Success
- GRD594 Management Fundamentals for Scientists and Engineers

- GRD595 Fundamentals of Budget & Finance

Math & Science: Many courses are acceptable but the student should discuss selection with their advisor or the ECE Graduate Director.

III. Requirements for the PhD Degree

The PhD program in Electrical Engineering meets the needs of each student through an individualized learning program. The program requires a minimum of eight (8) courses beyond the Master's. To meet the Residency Requirement, students must complete a minimum of 24 course-credits at Binghamton University (all of which could be independent studies if that is acceptable to the student's PhD advisor).

A. Full-Time Status and Continuous Registration

To maintain full-time status a post-MS PhD student must enroll for 9 graduate credits. A new PhD student who has not yet provided the graduate school with an official copy of a transcript showing the award of an MS degree must register for 12 credits to be full-time. Once a PhD student has completed all requirements except for defense of and submission of a dissertation only 1 credit of registration is needed for full-time status as long as the full-time certification form has been completed. The form for **full-time certification** can be found at http://www2.binghamton.edu/grad-school/new-and-current-students/forms-and-publications/; **please note that there is one form for funded students and one form for non-funded students**.

All students who have been admitted into a degree-granting program must maintain continuous registration each semester for a minimum of 1 credit hour of EECE700. Students who do not maintain registration are severed and may not return unless they reapply for admission and pay a new application fee. Students who are readmitted are required to register and pay for one credit for each semester they have not registered, plus one credit for the semester they re-enter, up to a maximum of four credits. Graduate students are not required to maintain matriculation during the summer unless they intend to complete their final degree requirements during this period. But students graduating in the summer must be registered for at least 1 credit in one (=any) summer session.

B. PhD Advisor & Guidance Committee

The PhD student's research advisor is central in directing the student's development. Upon admission to the doctoral program, new students have the ECE Graduate Director as their advisor until an advisor is identified on the PhD Principal Advisor/Guidance Committee Form. As the initial academic advisor, the ECE Graduate Director is responsible for (a) explaining the Watson School regulations governing the doctoral program; (b) assisting the student in establishing a course of study and finding an advisor; and (c) assisting the student in forming a guidance committee. These actions should be completed during the first semester in residence.

As soon as the student finds a faculty member to serve as his/her Principal Advisor, the student and advisor should identify faculty members to serve on the student's guidance committee. Initially, ***the guidance committee must have a minimum of three members with a minimum of two members (including the Principal Advisor) from ECE***. Each of these members is expected to take an active role in supervising the student's development. Members in addition to those mentioned above can be added to

enhance the committee, and a recommendation for an Outside Examiner will need to be made to the Graduate School so that the outside person can be appointed before dissertation defense (see more about the outside examiner in the section below on the Dissertation).

When a proposed committee has been identified, the names and signatures are submitted on a Principal Advisor/Guidance Committee Form to the ECE Graduate Director. Once approved by the ECE Graduate Director, the forms are forwarded to the Graduate Coordinator in the Dean's Office. Review of the proposed guidance committee is very thorough because the guidance committee monitors the student's academic progress. When the guidance committee is approved, the forms will be placed on file in the Dean's Office. Any subsequent changes made to the membership of the guidance committee must be documented in a new copy of the Principal Advisor/Guidance Committee Form.

C. Steps to Complete a PhD

The major steps in the completion of the PhD program include the following sequence of items (a) through (g), which are described in detail below. Although the presented order is typical, it is not necessary; however, only small deviations from this sequence are possible.

(a) Successful completion of a ***qualifying examination***
(b) Satisfactory completion of a ***learning contract***
(c) Demonstration of ***teaching proficiency***
(d) Completion of ***course work***
(e) Successful completion of a ***comprehensive examination***
(f) Advancement to ***Candidacy (also known as "ABD" status)***
(g) Acceptance of ***prospectus*** outlining dissertation research & Presentation of ***colloquium***
(h) Submission of ***Dissertation*** & oral defense of Dissertation

(a) PhD Qualifying Exam: Students are encouraged to attempt this examination as early as possible in their program, preferably within the first three semesters. The qualifying exam is given on the second Friday of the Fall and Spring Semesters. Details on the exam can be found in the appendix of this handbook.

The qualifying exam is used to assess the background of beginning PhD students and identify any areas of weakness that should be addressed early in the PhD program. On the qualifying examination, a student must demonstrate quantitative skills and subject knowledge within key areas of ECE.

The results from the examination are reviewed by the student's advisor with the ECE Graduate Committee, and the student is given an honest assessment of his/her progress toward the PhD. The possible recommendations of the Graduate Committee are: (1) satisfactory progress has been demonstrated; (2) the examination should be re-taken (can be taken three times); (3) the student should withdraw from the PhD program.

(b) Learning Contract: The new doctoral student should start to work immediately (even prior to taking the qualifying exam) with his/her advisor to develop a learning contract. The learning contact should be completed as early as possible in the student's PhD studies. The purpose of the learning contract is to define the knowledge and skills required in order to pass the comprehensive examination. Toward that, the learning contract will identify core courses and concepts, which must be mastered in order to provide breadth of background, as well as specialized courses and concepts that are germane to the proposed area of research. The learning contract may be modified later if additional knowledge is required, or if the field of research is changed. There is a template for the learning contract available at http://www2.binghamton.edu/watson/advising/pdfs/Learning-Contract.pdf

Once completed, a copy of the learning contract, with signatures indicating approval of the guidance committee, is placed in the student's file in the Dean's Office.

(c) Evidence of Proficiency in Teaching: In addition to the coursework and research, doctoral candidates must demonstrate proficiency in teaching. Doctoral students must meet a teaching requirement in one of the following ways:

(i) Be an instructor of record in an undergraduate course. Note, however, that generally full-time faculty are expected to be the primary instructor of undergraduate courses.
(ii) Completion of a teaching methods course (these are available on-line through the Graduate School) and the teaching of one or more seminars or a portion of a course.
(iii) History of teaching experience comparable to choices (a) or (b) above, approved by the guidance committee.

In this context, it is also important to note that all ECE graduate students are eligible for a *Certificate for College Teaching*, which cites a student's special accomplishments as a teacher/instructor of electrical and computer engineering. Note that this certificate may be especially useful to doctoral students who wish to pursue an academic career. A description of the certificate may be found at: http://gradschool.binghamton.edu/cs/teachcolluniv.asp

(d) Completion of Coursework: PhD students are required to complete 24 credits of course work beyond a Masters degree. These 24 credits can include regular courses and independent study courses; pre-dissertation and dissertation credits don't count towards this requirement. The specific selection of courses to be taken must be outlined in the learning contract.

(e) Comprehensive Examination: After completion of the 24 credit residency requirement, and before completion of a significant portion of the dissertation research, a student must complete the Comprehensive Examination. This is an individual examination with the responsibility for the content given to the student's guidance committee. The ECE Graduate Director is an ex-officio member of the comprehensive examination to assure uniformity in the level of examinations within the Department. Once the members of guidance committee have agreed on the examination content and format, it will be clearly explained to the student and the examination date set.

(f) Admission to Candidacy: After successfully completing the comprehensive examination, and any additional requirements such as the development of communication skills, the student can be admitted to candidacy for the doctorate. The Graduate Office is notified of the satisfactory completion of the comprehensive examination and the student's admission to candidacy on the Recommendation for Admission to Candidacy for Doctoral Degree Form. The student has six months from completion of the comprehensive requirement to submit an approved prospectus to the Watson School Graduate Coordinator. ***Note that the candidate is required to defend the dissertation within five years of admission to candidacy.***

(g) Prospectus Submission & Colloquium Presentation: Upon completion of the comprehensive examination and admission to candidacy, the candidate prepares a written prospectus that identifies: (i) the research topic to be undertaken, (ii) the relevance of the results-to-date, and (iii) a proposed approach for completing the dissertation project. The prospectus is presented and defended in an open colloquium. Upon acceptance of the prospectus by the guidance committee, a copy is filed with the Watson School Graduate Coordinator. The written prospectus should conform to IEEE manuscript guidelines, and be at least ten pages in length.

(h) Dissertation and Defense: With the guidance of the dissertation advisor, the student completes the research and prepares a dissertation, which is an original written contribution demonstrating originality and competence in the chosen field of research. The guidance committee has direct charge of all matters pertaining to the dissertation, which must have the committee's unanimous approval before arrangements

are made for the final examination for the degree. The dissertation is to comply with the format and filing requirements set forth in the *Graduate School Student Handbook*; please see the following link: http://www2.binghamton.edu/grad-school/new-and-current-students/graduate-school-manual/index.html#thesis-or-dissertation

If an Outside Examiner was not chosen at the time the Principal Advisor/Guidance Committee Form was submitted, then the chair of the guidance committee makes a recommendation to the ECE Graduate Director, who upon approval forwards it to the Vice-Provost and Dean for Graduate School. For details on choice of Outside Examiner see http://www2.binghamton.edu/grad-school/new-and-current-students/graduate-school-manual/index.html#academic-doctoral. The Vice-Provost makes a formal appointment of the Outside Examiner. The Outside Examiner reviews and participates in the dissertation defense with the guidance committee. After distributing the dissertation for review, an oral defense of the PhD dissertation is scheduled. The PhD candidate is required to present an oral defense of his/her dissertation in an open colloquium. Upon satisfactory defense of the dissertation, the ECE Graduate Director submits a signed copy of the Recommendation for Award of Doctoral Degree Form to the Graduate Coordinator in the Dean's Office.

Note that before signing the Recommendation for Award of Doctoral Degree Form, the ECE Graduate Director needs to ascertain that all the necessary milestones defined above for the completion of the doctoral degree, including the learning contract, coursework, qualifying and comprehensive examinations, presentation of prospectus, and admission to candidacy have been passed satisfactorily.

After verification of completion of the program of study, the Graduate Coordinator forwards the recommendation form to the Graduate Office. Note that all the forms and other paperwork for the graduate program are available in the Watson School Graduate Advising Office.

Appendix: Ph.D. Qualifying Exam Overview

The following outlines the details for the Qualifying Exam:

- The exam is given at the beginning of each semester.
- The exam is 4 hours long.
- The exam consists of 4 questions on math topics (2 CoE-oriented and 2 EE-oriented) as well as 2 questions in each of 9 areas (See below for a list of areas)
- Students are required to complete 2 of the 4 math questions and 4 of 18 other questions
    - The expected scenario is: Student would do 2 from one area and 2 from a second area
    - But student can do any combination as long as they do 4 out of the 18 area questions
- Grading will consist of the following
    - Each answered question is graded on the basis of 10 points
    - Thus, the maximum total achievable is 60 points
    - The ECE Grad. Studies Committee will review graded results and decide Pass/Fail for each student
- Students are allowed 2 attempts to pass
    - If they fail the first time they must retake the entire exam
- Students are allowed to bring:
    - One 8.5”x11” sheet of notes (both sides)
    - A Calculator
    - Reference tables will be provided if needed (e.g., Fourier transforms, etc.)
- Areas of the Exam
    - Mathematics (Required)
    1. Digital Signal Processing
    2. Communications
    3. Controls
    4. Digital Design
    5. Computer Architecture
    6. Computer Networks
    7. Electronics
    8. Semiconductors
    9. Electro-Magnetics/Optics

Details on the topics covered in each area of the exam are available from the ECE Graduate Director.