MS and PhD Degree Requirements

Department of Electrical and Computer Engineering

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General Information on ECE Graduate Courses

This document is prepared to assist ECE graduate students know the necessary steps and the corresponding deadlines for graduating from the ECE department.

Before reading this document make sure you know the meaning of **DEPTH**, **BREADTH**, and **EXCLUDED** courses as explained below:

Depth Courses: These courses provide depth of knowledge in one of the five ECE concentrations (CCSP, CMPE, EMPO, MSMD, POWR). Your depth courses depend on your concentration and are listed under "Depth Courses" for *your* concentration (see pages 10–14). Depth courses can be either ECE or non-ECE courses (for instance, Computer Engineering concentration, CMPE, has many CS courses listed under "Depth Courses"). *No petition is required* to take depth courses; this applies to both ECE and non-ECE depth courses. Please note that in some documents "Depth Courses" are referred to as "Approved Concentration Courses"; there is no difference between these two.

Breadth Courses: These courses are required to provide knowledge in areas besides your concentration. Any acceptable graduate-level course **that is not a depth course for your concentration** (i.e., is not listed under the "Depth Courses" of *your concentration*) is considered as a "Breadth Course".

There are two categories of breadth courses:

1-Courses listed as depth courses of an ECE concentration different from yours: These can be ECE or non-ECE courses. Taking these courses *does not require a petition.*

2-Courses that are not depth courses for *any* ECE concentration: These are generally non-ECE, graduate-level courses. Taking these courses *requires filing a petition, and getting its approval, **before registering in the course**.* The details of how to file a petition are later explained in this document.

Computer Engineering students ***cannot*** select their breadth courses from College of Computer and Information Science.

Excluded Courses These courses *cannot* be selected as part of your MSECE program and, therefore, cannot be petitioned. These are generally non-ECE courses.

Checklist for MSECE Couse-only Track

Please use the following checklist for successful progress towards MSECE (course-only track):

Step 1 Make sure that you know your assigned academic advisor and consult with him/her regularly. It is essential that you meet your academic advisor during the first two weeks of each semester and review your course selection with him/her.

Step 2 Plan a program of study for your degree *in consultation with your academic advisor*. Make sure that all prerequisites are taken before the time you plan to register in a course. You need to complete **32 SH** of course work to graduate. The details are given below.

Step 3 **Depth Requirements:** Refer to the list of "Depth Courses" for *your concentration* on pages 10–14. You need to take and successfully complete ***at least five*** "Depth Courses" (20 SH).

Step 4 **Breadth Requirements:** Graduate level courses outside your "Depth Courses", whether in ECE or in a closely related department, can be taken as "Breadth Courses". You need to complete ***at least two*** "Breadth Courses" (8 SH).

Note 1 If you plan to take a non-ECE breadth course that is *not* on the list of "Depth Courses" of *any* of the five ECE concentration, you need to file a petition *before registration in the course* and have your advisor sign it. You then scan the petition, save it as a pdf file and email it with a pdf copy of your transcripts to Faith Crisley at `f.crisley@neu.edu` with subject "Petition from XXX ID number YYY", where XXX is your complete name and YYY is your NUID. Note that filing a petition does not mean that it necessarily will be approved. Also, note that computer engineering students cannot select their breadth courses from College of Computer and Information Science.

Note 2 Courses that are listed under "Excluded Courses" cannot be taken towards the MSECE degree. Please do not file petition to take these courses. Such petitions are automatically rejected.

Note 3 The total number of non-ECE courses that you can take, *whether they are depth or breadth courses*, cannot be more than two courses (8 SH). Computer Engineering students can take up to three non-ECE courses (12 SH).

Note 4 You may register for EECE7400 (Special Problems in ECE, 1–4 SH) for a total of *at most* 4 SH in your MSECE program. Registration in this course requires filing a petition (see Note 1 above on how to file a petition).

Note 5 A maximum of 9 SH of graduate level course work can be transferred from other institutions. Transfer credit is subject to approval of the Graduate Affairs Committee (GAC) and requires filing a petition (see Note 1 above on how to file a petition). You need to have a grade of at least B in transfer courses. Transfer courses should not have been previously counted towards obtaining a degree.

Note 6 To graduate you must have a cumulative GPA of at least 3.00 with no more than 8 semester hours of grades below B- in all courses applied to the degree.

Step 5 You graduate when you have successfully passed 32 SH of course work and have satisfied all the conditions explained above.

Checklist for MSECE Thesis-Course Track

Please use the following checklist for successful progress towards MSECE (thesis-course track):

Step 1 Make sure that you know your assigned academic advisor and consult with him/her regularly. It is essential that you meet your academic advisor during the first two weeks of each semester and review your course selection with him/her.

Step 2 Talk to the ECE faculty about their research interests and find a research advisor whose area matches your interests and background. Your research advisor can be any tenured, tenure-track, affiliated, or adjunct ECE faculty. After finding a research advisor, he/she will be your academic advisor as well (if your research advisor is *not* a tenured/tenure-track ECE faculty, your originally assigned academic advisor will continue to serve as your advisor). The deadline for finding a research advisor is *one year after your matriculation* at NEU.

Step 3 Plan a program of study for your degree *in consultation with your advisor*. Make sure that all prerequisites are taken before the time you plan to register in a course. You need to complete **24 SH of courses and 8 SH of MS thesis** to graduate. The details are given below.

Step 4 **Depth Requirements:** Refer to the list of "Depth Courses" for *your concentration* on pages 10–14. You need to take and successfully complete ***at least three*** "Depth Courses".

Step 5 **Breadth Requirements:** Graduate level courses outside your "Depth Courses", whether in ECE or in a closely related department, can be taken as "Breadth Courses". You need to complete ***at least two*** "Breadth Courses" (8 SH).

Note 1 If you plan to take a non-ECE breadth course that is *not* on the list of "Depth Courses" of *any* of the five ECE concentration, you need to file a petition *before registration in the course* and have your advisor sign it. You then scan the petition, save it as a pdf file and email it with a pdf copy of your transcripts to Faith Crisley at `f.crisley@neu.edu` with subject "Petition from XXX ID number YYY", where XXX is your complete name and YYY is your NUID. Note that filing a petition does not mean that it necessarily will be approved. Also, note that computer engineering students cannot select their breadth courses from College of Computer and Information Science.

Note 2 Courses that are listed under "Excluded Courses" cannot be taken towards the MSECE degree. Please do not file petition to take these courses. Such petitions are automatically rejected.

Note 3 The total number of non-ECE courses that you can take, *whether they are depth or breadth courses*, cannot be more than three courses (12 SH).

Note 4 You may register for EECE7400 (Special Problems in ECE, 1–4 SH) for a total of *at most* 4 SH in your MSECE program. Registration in this course requires filing a petition (see Note 1 above on how to file a petition).

Note 5 A maximum of 9 SH of graduate level course work can be transferred from other institutions. Transfer credit is subject to approval of the Graduate Affairs Committee (GAC) and requires filing a petition (see Note 1 above on how to file a petition). You need to have a grade of at least B in transfer courses. Transfer courses should not have been previously counted towards obtaining a degree.

Step 6 **Thesis Requirements:** You need to register for 8 SH in EECE 7990 (Master's Thesis). This is usually done in two semesters, each semester 4 SH, but can also be done in one semester for 8 SH.

Note 1 If after taking 8 SH of EECE 7990 (Master's Thesis), you have not yet successfully defended your thesis, you need to register each semester in EECE 7996 (Master's Thesis Continuation, 0 SH) until you defend your thesis.

Note 2 When you are ready to defend your thesis, you need to form a "Thesis Committee" in consultation with your advisor. The Committee must have at least three members, and at least two of the members must be tenured or tenure-track ECE faculty. After successful defense of your thesis a letter grade will be assigned to EECE 7990 (Master's Thesis).

Step 7 You graduate when you have successfully defended your thesis and fulfilled your course requirements. To graduate you must have a cumulative GPA of at least 3.00 with no more than 8 semester hours of grades below B- in all courses applied to the degree.

Checklist for PhD Students Entering with MS Degree

Step 1 Make sure that you know your assigned academic advisor and consult with him/her regularly. It is essential that you meet your academic advisor during the first two weeks of each semester and review your course selection with him/her.

Step 2 Talk to the ECE faculty about their research interests and find a research advisor whose area matches your interests and background. Your research advisor can be any tenured, tenure-track, affiliated, or adjunct ECE faculty. After finding a research advisor, he/she will be your academic advisor as well (if your research advisor is *not* a tenured/tenure-track ECE faculty, your originally assigned academic advisor will continue to serve as your advisor). The deadline for finding a research advisor is *one year after your matriculation* at NEU.

Step 3 Plan a program of study for your degree *in consultation with your advisor*. Make sure that in your plan all prerequisites are taken before registering in a course.

Step 4 **Course Requirements:** You need to complete at least 16 SH of graduate level course work beyond Master's degree.

- **Note 1** Typically, students take more than 16 SH — usually 24 SH or even more.
- **Note 2** Courses are selected in consultation with your research advisor.
- **Note 3** At least 8 SH of your courses must be graduate-level ECE courses.
- **Note 4** If you plan to take a non-ECE course that is *not* on the list of "Depth Courses" of *any* of the five ECE concentration, you need to file a petition *before registration in the course* and have your advisor sign it. You then scan the petition, save it as a pdf file and email it with a pdf copy of your transcripts to Faith Crisley at `f.crisley@neu.edu` with subject "Petition from XXX ID number YYY", where XXX is your complete name and YYY is your NUID. Note that filing a petition does not mean that it necessarily will be approved.
- **Note 5** You may register for EECE7400 (Special Problems in ECE, 1–4 SH) for a total of *at most* 4 SH in your PhD program. Registration in this course requires filing a petition (see Note 4 above on how to file a petition).
- **Note 6** A maximum of 9 SH of graduate level course work can be transferred from other institutions. Transfer credit is subject to approval of the Graduate Affairs Committee (GAC) and requires filing a petition (see Note 4 above on how to file a petition). You need to have a grade of at least B in transfer courses. Transfer courses should not have been previously counted towards obtaining a degree.
- **Note 7** To graduate you must have a cumulative GPA of at least 3.00 with no more than 8 semester hours of grades below B- in all courses applied to the degree.

Step 5 **Qualifying Exam:** You have to register for and take the qualifying exam in your concentration in the spring of your first year at Northeastern. If you start your program in the spring semester you can postpone the exam until the next spring.

Note 1 If you do not pass the qualifying exam in your first attempt, you have to retake it the next spring. This will be your last chance to pass the qualifying exam.

Note 2 If you want to do research before passing the qualifying exam, you need to register in EECE 9986 (Research, 0 SH) under your advisor's name.

Note 3 After passing the qualifying exam, your status changes from "Predoctoral Student" to "PhD Candidate".

Step 6 You must register in EECE 9990 (Dissertation, 0 SH) for two consecutive semester immediately after passing the qualifying exam.

Note If after two consecutive semesters of taking EECE 9990 you have not yet defended your dissertation (this is very typical), you must register in EECE 9996 (Dissertation Continuation, 0SH) in each semester until you successfully defend your dissertation.

Step 7 **Dissertation Committee:** Within six months after passing the qualifying exam, you must form your "Dissertation Committee" in consultation with your advisor. This Committee must have at least three members of which at least two must be tenured or tenure-track ECE faculty.

Step 8 **Comprehensive Exam:** Within two years after passing the qualifying exam, you schedule your "Comprehensive Exam" (also known as "Proposal Defense").

Note 1 The Comprehensive Exam consists of a presentation of your research proposal followed by a question/answer session by your Dissertation Committee. The presentation part of this exam is open to faculty and students.

Note 2 After passing the Comprehensive Exam, the "Comprehensive Exam Form" is signed by the Committee Chair and is filed with the graduate administrator.

Step 9 **Dissertation Defense:** Dissertation defense is usually the last stage in PhD requirements. The dissertation defense consists of a presentation of your research results followed by a question/answer session by your Dissertation Committee. The presentation part of this exam is open to faculty and students. The dissertation defense is typically one year, or more, after the Comprehensive Exam.

Step 10 **Residency Requirement:** You need to be registered full-time at NU for at least two semesters after candidacy to be eligible for your degree. The two summer half-semesters count as a full semester. For part-time Ph.D. students, four semesters of part-time registration fulfills the residency requirement.

Step 11 You graduate when you have successfully defended your dissertation and fulfilled your course and residency requirements.

Checklist for PhD Students with no MS Degree

Step 1 Make sure that you know your assigned academic advisor and consult with him/her regularly. It is essential that you meet your academic advisor during the first two weeks of each semester and review your course selection with him/her.

Step 2 Talk to the ECE faculty about their research interests and find a research advisor whose area matches your interests and background. Your research advisor can be any tenured, tenure-track, affiliated, or adjunct ECE faculty. After finding a research advisor, he/she will be your academic advisor as well (if your research advisor is *not* a tenured/tenure-track ECE faculty, your originally assigned academic advisor will continue to serve as your advisor).

Step 3 Plan a program of study for your degree *in consultation with your advisor*. Make sure that in your plan all prerequisites are taken before registering in a course.

Step 4 **Course Requirements:** You need to satisfy the requirements of MS/C or MS/T, plus the course requirements for PhD students with MS. Please refer to these three document for details.

- **Note 1** The decision on whether you should follow the requirements of MS/T or MS/C is made in consultation with your research advisor.
- **Note 2** After completing the requirements for MS/T or MS/C, if interested, you can file a petition to receive an MSECE degree.

Step 5 **Qualifying Exam, Comprehensive Exam, Dissertation Defense:** These requirements are similar to those on "Checklist for PhD Students with MS Degree". Please refer to pages 7–8.

Depth and Excluded Courses

Depth Courses for Communication, Control, and Signal Processing

EECE 5576 Wireless Communication Systems 4 SH
EECE 5580 Classical Control Systems 4 SH
EECE 5610 Digital Control Systems 4 SH
EECE 5639 Computer Vision 4SH
EECE 5664 Biomedical Signal Processing 4SH
EECE 5666 Digital Signal Processing 4SH
EECE 5688 Image Processing and Pattern Recognition 4SH
EECE 5698 Special Topics Introduction to Machine Learning 4SH
EECE 5968 Special Topics in Security 4SH
EECE 7200 Linear Systems Analysis 4 SH
EECE 7203 Complex Variable Theory and Differential Equations 4 SH
EECE 7204 Applied Probability and Stochastic Processes 4 SH
EECE 7211 Nonlinear Control 4 SH
EECE 7213 System Identification and Adaptive Control 4 SH
EECE 7214 Optimal and Robust Control 4 SH
EECE 7242 Integrated Circuits for Communications and Analog Signal Processing 4 SH
EECE 7245 Microwave Circuit Design for Wireless Communications 4 SH
EECE 7293 Modern Imaging 4 SH
EECE 7310 Modern Signal Processing 4 SH
EECE 7311 Two Dimensional Signal and Image Processing 4 SH
EECE 7312 Statistical and Adaptive Signal Processing 4 SH
EECE 7313 Pattern Recognition 4 SH
EECE 7315 Digital Image Processing 4 SH
EECE 7323 Numerical Optimization Methods 4 SH
EECE 7332 Error Correcting Codes 4 SH
EECE 7334 Wireless Communications 4 SH
EECE 7335 Detection and Estimation Theory 4 SH
EECE 7336 Digital Communications 4 SH
EECE 7337 Information Theory 4 SH
EECE 7364 Mobile and Wireless Networking 4 SH
EECE 7398 Special Topics in Wireless Cognitive Radio Networks 4 SH

Depth Courses for Computer Engineering

ECE Courses

EECE 5639 Computer Vision 4SH
EECE 5640 High Performance Computing 4SH
EECE 5688 Image Processing and Pattern Recognition 4SH
EECE 5698 Special Topics Introduction to Visualization 4SH
EECE 5968 Special Topics in Security 4SH
EECE 5698 Special Topics Introduction to Machine Learning 4SH
EECE 5640 High Performance Computing 4SH
EECE 5698 Special Topics Computer Security 4SH
EECE 7205 Fundamentals of Computer Engineering 4 SH
EECE 7240 Analog Integrated Circuit Designs 4 SH
EECE 7313 Pattern Recognition 4 SH
EECE 7332 Error Correcting Codes 4 SH
EECE 7334 Wireless Communications 4 SH
EECE 7352 Computer Architecture 4 SH
EECE 7353 VLSI Design 4 SH
EECE 7357 Fault-Tolerant Computers 4 SH
EECE 7360 Combinatorial Optimization 4 SH
EECE 7364 Mobile and Wireless Networking 4 SH
EECE 7368 High Level Design of Hardware Software Systems 4 SH
EECE 7369 Simulation and Performance Evaluation 4SH
EECE 7374 Fundamentals of Computer Networking 4SH
EECE 7388 Special Topics: Computer Vision 2 4 SH

Mathematics Courses

MATH 7232 Combinatorial Analysis 4 SH
MATH 7233 Graph Theory 4 SH

CCIS Courses (subject to space availability, offering and approval from CCIS)

CS 5100 Foundations of Artificial Intelligence 4 SH
CS 5200 Introduction to Database Systems 4 SH
CS 5210 Implementation of Database Management Systems 4 SH
CS 5310 Computer Graphics 4 SH
CS 5340 Computer-Human Interaction 4 SH
CS 5400 Principles of Programming Languages 4 SH
CS 5500 Managing Software Development 4 SH
CS 5600 Computer Systems 4 SH
CS 5770 Software Vulnerabilities and Security 4 SH

CS 6110 Knowledge-based Systems 4 SH
CS 6200 Information Retrieval 4 SH
CS 6310 Computational Imaging 4 SH
CS 6410 Compilers 4 SH
CS 6510 Advanced Software Development 4 SH
CS 6520 Methods of Software Development 4 SH
CS 6530 Analysis of Software Artifacts 4 SH
CS 6540 Foundations of Formal Methods and Software Analysis 4 SH
CS 6610 Parallel Architectures and Algorithms 4 SH
CS 6740 Network Security 4 SH
CS 6750 Cryptography and Communication Security 4 SH
CS 6760 Privacy, Security and Usability 4 SH
CS 6810 Distributed Algorithms 4 SH
CS 7800 Advanced Algorithms 4 SH

Depth Courses for Electromagnetics, Plasma, and Optics

EECE 5648 Biomedical Optics 4 SH
EECE 7105 Optics for Engineers 4 SH
EECE 7202 Electromagnetic Theory 1 4 SH
EECE 7203 Complex Variable Theory and Differential Equations 4 SH
EECE 7245 Microwave Circuit Design for Wireless Communication 4 SH
EECE 7270 Electromagnetic Theory 2 4 SH
EECE 7271 Computational Methods in Electromagnetics 4 SH
EECE 7275 Antennas and Radiation 4 SH
EECE 7276 Microwave Properties of Materials 4 SH
EECE 7284 Optical Properties of Matter 4 SH
EECE 7285 Optoelectronics and Fiber Optics 4 SH
EECE 7287 Optical Detection 4 SH
EECE 7293 Modern Imaging 4 SH
EECE 7309 Special Topics in Electromagnetics, Plasma, Optics 4 SH

Depth Courses for Microsystems, Material, and Devices

EECE 5606 Micro- and Nanofabrication 4 SH
EECE 5648 Biomedical Optics 4 SH
EECE 5680 Electric Drives 4 SH
EECE 5696 Energy Harvesting Systems 4 SH

EECE 7201 Solid State Devices 4 SH
EECE 7240 Analog Integrated Circuit Design 4 SH
EECE 7241 Advanced Solid State Devices 4 SH
EECE 7242 Integrated Circuits for Communications and Analog Signal Processing 4 SH
EECE 7243 Integrated Circuit Fabrication 4 SH
EECE 7244 Introduction to Microelectromechanical Systems (MEMS) 4 SH
EECE 7245 Microwave Circuit Design for Wireless Communication 4 SH
EECE 7246 Design and Analysis of Digital Integrated Circuits 4 SH
EECE 7247 Radio Frequency Integrated Circuit Design 4 SH
EECE 7353 VLSI Design 4 SH
EECE 7276 Microwave Properties of Materials 4 SH
EECE 7284 Optical Properties of Matter 4 SH
EECE 7398 Special Topics in Magnetic Materials 4 SH

Depth Courses for Power Systems, Power Electronics, and Motion Control

EECE 5580 Classical Control Systems 4 SH
EECE5610 Digital Control Systems 4SH
EECE5666 Digital Signal Processing 4SH
EECE 5684 Power Electronics 4SH
EECE5686 Electrical Machines 4SH
EECE 5688 Analysis of Unbalanced Power Networks 4SH
EECE 5694 Numerical Optimization 4SH
EECE 5698 Special Topic: Energy Harvesting Systems 4 SH
EECE 7200 Linear System Analysis 4SH
EECE 7211 Nonlinear Control 4SH
EECE 7212 Multivariable Control Systems 4SH
EECE 7213 System Identification and Adaptive Control 4SH
EECE 7214 Optimal and Robust Control 4SH
EECE 7220 Power System Analysis 2 4SH
EECE 7221 Power Systems Operation and Control 4SH
EECE 7323 Numerical Optimization Methods 4SH
EECE 7224 Power System State Estimation 4SH
EECE 7226 Modeling of Transients in Power Systems 4SH
EECE 7236 Special Topics in Control 4SH
EECE 7237 Special Topics in Power Electronics 4SH
EECE 7238 Special Topics in Electric Drive 4SH
EECE 7239 Special Topics in Power Systems 4SH

EECE 7310 Modern Signal Processing 4SH

EECE 7312 Statistical and Adaptive Signal Processing 4SH

EECE 7325 Special Topics in Signal Processing 4SH

EECE 7335 Detection and Estimation 4SH

ENGR 5670 Sustainable Energy 4SH

Excluded Courses for All Concentrations

CS 5010 Programming Design Paradigm 4SH

CS 5320 Digital Image Processing 4SH

CS 5330 Pattern Recognition and Computer Vision 4SH

CS 5520 Mobile Application Development 4SH

CS 5610 Web Development 4SH

CS 5700 Computer Networks 4SH

CS 5800 Algorithms 4SH

CS 6350 Empirical Research Methods 4SH

CS 6120 Natural Language Processing 4SH

CS 6710 Wireless Networks 4SH

In addition to these courses, all courses offered by the Professional Masters Programs (Computer Systems Engineering, Energy Systems, Engineering Entrepreneurship, Engineering Management, Information Systems, Sustainable Building Systems, and Telecommunications Systems Management) are also excluded, except those explicitly listed under “Depth Courses” of one of the ECE concentrations.