# Portland State University

# Department of Electrical and Computer Engineering


# Graduate Student Handbook

**Last updated: May 3, 2011**

# TABLE OF CONTENTS

NOTE: It is the student's responsibility to carefully read and follow the recommendations, requirements, and procedures described in this handbook. Please consult the PSU Bulletin, the PSU quarterly Schedule of Classes, or the ECE Department Office for questions not addressed in this handbook.

# I. GRADUATE PROGRAMS IN ELECTRICAL AND COMPUTER ENGINEERING

A Master of Engineering (M.Eng.) requires a total of 45 graduate credits. The minimum requirements are as follows: 36 credits of ECE lecture credits and 9 elective graduate credits.

A Master of Science (M.S.) degree in Electrical and Computer Engineering requires a total of 45 graduate credits. Both thesis options and comprehensive exam options are available.

A candidate for the Ph.D. degree in electrical and computer engineering must complete a minimum of 80 graduate credits, consisting of at least 45 ECE graduate credits, 8 elective graduate course credits and at least 27 credits of ECE 603 (dissertation). Of the 45 ECE credits, 32 credits must come from ECE lecture courses (24 lecture credits if the student successfully completed an ECE MS Thesis). The 8 elective credits may come from any academic department, but must be lecture credits only. One additional graduate credit is required to meet the University specified minimum total of 81 credits for a Ph.D.

A Graduate Certificate of Specialization is awarded for successful completion of an approved course sequence within a specific area of Electrical and Computer Engineering. The courses in a sequence include a substantial graduate-level body of knowledge. Courses completed for a Graduate Certificate of Specialization may subsequently be applied toward master's and/or doctoral degrees. The certificate programs are intended primarily to provide enrichment for professional engineers and scientists who may not initially wish to pursue a more extended M.Eng., M.S., or Ph.D. degree program. *Any course used to obtain one graduate certificate may not be used to obtain another graduate certificate.*

Lecture courses taken under the undifferentiated grading option (P/NP) shall not be used to fulfill ECE graduate degree program requirements.

Graduate level course work includes classes in intelligent robotics, design automation tool design, design for test, automatic control theory, linear systems, power electronics, digital signal processing, communication systems, analog and digital circuit design, computer architecture, computer vision, evolutionary computation, and high-frequency design. Classes are scheduled to best accommodate both full-time and part-time students.

Extensive computing facilities are available for instruction and research in the Department of Electrical and Computer Engineering. A high-speed local area network with 40+ Sun SPARC workstations allows grad students to do courses and research work with all the latest tools from Mentor Graphics, Cadence, Synopsys, and others. Another LAN with 60+ PC type machines provides student access to the latest PC based tools. Several research labs also have specialized computers as required for the work being done.

Laboratories dedicated to specific research areas include laboratories for IC Design and Test, Industrial Robotics, Communications, Power Electronics, Electromagnetics and Micro-wave Circuits, Analog Integrated Circuit Design, DSP, and VLSI Design Automation. In addition, a number of instructional laboratories are frequently used for research projects, including the Intel

Microprocessor Design Laboratory, The VLSI Design Laboratory, and the Digital Signal Processing Laboratory.

General degree requirements are outlined below and in the latest edition of the Portland State University Bulletin. Please see http://www.ece.pdx.edu for additional information. You may also write to or call:

Department of Electrical and Computer Engineering,
Portland State University, P.O. Box 751,
Portland Oregon 97207-0751
Telephone (503) 725-3806
E-mail address: graduate.info@ece.pdx.edu

# II. ADMISSION

NOTE: IF YOU DO NOT REGISTER FOR AN ECE CLASS DURING THE TERM TO WHICH YOU ARE ADMITTED, YOUR ADMISSION WILL AUTOMATICALLY BE CANCELLED. TO PREVENT YOUR ADMISSION FROM BEING CANCELLED, YOU MUST NOTIFY BOTH THE ECE DEPARTMENT AND THE OFFICE OF ADMISSIONS OF YOUR INTENT TO CHANGE THE TERM OF ENROLLMENT. MOREOVER, NOTIFICATION MUST BE GIVEN PRIOR TO THE TERM FOR WHICH YOU ARE ADMITTED.

## *Master's Admission Requirements*

Applicants who have completed a Bachelor's of Science (B.S). degree in either Electrical or Computer Engineering at a recognized university with a grade point average of 3.00 or better in all junior and senior level technical courses may be considered for admission to the Department of Electrical and Computer Engineering as regular graduate students. Students who have completed a B.S. degree in a related field (normally either mathematics, physics, computer science or mechanical engineering) or applicants with a B.S. ECE degree and a grade point average in their upper division technical coursework below 3.00 but higher than 2.75 may be granted conditional admission status. (See section below for comments regarding applicants with a B.S. degree in a field other than Electrical or Computer Engineering.) Applicants whose B.S. degree is from a university where English is not the native language must provide proof of English language proficiency as required by International Admissions.

Admission is possible in any quarter of the year, but applications for Spring or Summer term are discouraged. Most course sequences begin in the Fall or Winter quarters, and students who arrive in spring or summer may not find suitable courses for their study plans.

## *Doctoral Admission Requirements*

A student applying to the Ph.D. program in Electrical and Computer Engineering will be required to demonstrate an acceptable level of performance in the GRE examination and to have

completed an M.Eng. or M.S. degree in Electrical and Computer Engineering or a related field. Applicants whose B.S. degree is from a university where English is not the native language, must satisfy PSU English language proficiency requirements.

Admission is possible in any quarter of the year, but applications for Spring or Summer term are discouraged. Most course sequences begin in the Fall or Winter quarters, and students who arrive in spring or summer may not find suitable courses for their study plans.

## *Application Procedure*

Applications to ECE Graduate Programs are handled jointly by the University's Office of Admissions and the ECE Department. Applicants must provide the following items:

***Submit to the University Office of Admissions:***

- University application form.(See instructions on form)
- Non-Refundable application fee. (Currently $50)
- Measles Vaccination form.
- Official transcripts from every post-secondary institution you have attended.
- Additional University requirements for International Students:
    - Proof of English language proficiency
    - Declaration of finances and an Affidavit of support form.
    - Evidence of adequate financial resources for you studies at PSU
    - (Non-US applicants must demonstrate that they have sufficient funds available to support themselves for one year in the United States before the Admissions Office of Portland State University will issue an I-20 (Certificate of Eligibility for Non-Immigrant Student Status. Currently this level is set at $21,809 US).

***Submit to the Electrical & Computer Engineering Department:***

- Departmental Application form.
- Applicant Questionnaire.
- Copies of transcripts from every post-secondary institution you have attended (unofficial transcripts are acceptable for Department requirements).
- English translations of transcripts for international students are required.
- Three letters of reference sent directly from the author in a signed and sealed envelope.
- (**M.S. and Ph.D. applicants)** Official reporting of the general **GRE scores** with a test date within two years. School code: 4610 (PSU); Dept. code: 1203 (Electrical Engineering) or 1201 (Computer Engineering). Note: only general test scores are required; subject test scores are not required.
- (**M.S. applicants only**) GRE requirement waived if applicant graduated from an ABET accredited degree program in electrical or computer engineering.

***Deadlines***

The official deadlines for submission of all materials (to both offices) are as follows:

| Term | Standard Deadline | International Student Deadline |
|---|---|---|
| Fall | April 1 | March 1 |
| Winter | September 1 | July 1 |
| Spring | November 1 | November 1 |

## *Non-ECE B.S. Degree Holders*

A considerable number of recent ECE graduate students have B.S. or B.A. degrees in fields other than ECE. Graduate student applicants who do not have a B.S. degree in Electrical or Computer Engineering, must obtain and demonstrate an acceptable level of knowledge of the material contained in the undergraduate Electrical and Computer Engineering classes. This is done by successfully completing a specified set of ECE undergraduate classes with a grade of "B" or better for each class. Applicants in this category should meet with the ECE Associate Department Chair for Undergraduate Affairs or a designated adviser to determine the set of undergraduate classes that is appropriate for their specific program. The next sections describe the mechanisms for taking PSU classes before being officially admitted to the ECE graduate program.

## *Non-admitted Students*

PSU allows students to take up to 8 credit hours per term without having been formally admitted to a degree program. First-time registrants must provide a completed Quick Entry Form (available on the web at http://www.pdx.edu/admissions/ugrad_qkentry.html or in the paperback schedule of classes). Completion of this form will allow registration by touch-tone phone or on the web. See http://www.pdx.edu for information on electronic registration. Note that non-admitted students are last in line to register for classes, so they may not be able to get into popular class sections.

## *Post-Baccalaureate Students*

PSU has a post-baccalaureate (PB) program for students who already hold a bachelor's degree but wish to take further courses for credit. This program is primarily intended for students who wish to earn a second bachelor's degree in a new field. However, it is also useful to prospective graduate students who wish to take undergraduate and/or graduate classes to prepare for application to the graduate program. The advantages of obtaining PB status rather than just taking courses as a non-admitted student are that you can register for more than 8 credits per quarter, and you can register for courses earlier than non-admitted students can. PB students taking all undergraduate courses pay undergraduate fees. However, if you take one or more graduate classes in a given quarter, you then pay graduate fees for ALL the classes you take during that quarter.

To obtain PB status you must formal apply to the University for admission. The admission deadlines are the same as for ordinary graduate admission. Admission to the PB program is not competitive; it is normally automatic provided you hold an undergraduate degree from an accredited institution. You must also have a cumulative GPA of 2.00 (2.25 for nonresidents) for any work taken after your bachelor's degree. Be advised that a limit of 15 credits of graduate level work taken before formal admission can be applied to a master's degree program.

# III. SUPPORT

## *Advising and Study Plans*

Upon admission to a Master's or Doctoral program, you will be assigned to a faculty member who will serve as your academic adviser. Coursework taken without adviser approval may not be accepted as part of a student's program.

Students may change advisors as their study plans develop (form in ECE Office), and a faculty member may withdraw from serving as thesis / dissertation adviser to an M.S. or Ph.D. student. The faculty recognizes its responsibility to provide adequate advising to all students, and the departmental Graduate Coordinator will ensure that all graduate students have an academic adviser. To successfully complete an M.S. thesis or Ph.D. dissertation, it is essential that you work very closely with your adviser.

## *Computer Accounts*

Most of your general, computer-based work in the Electrical or Computer Engineering program will be done on the UNIX (Solaris) based SPARCs or on the Windows NT based PCs in the Fourth Avenue Building (FAB). When you enroll in an ECE class that requires the use of a particular computer system, you will automatically be given an account on that system. To activate your account and receive your password, go to the Desk Operations Group (DOG) office, Engineering Building room 82-01 and show your student ID.

If you need a computer account beyond those provided automatically, then contact the Computer Action Team (CAT) for assistance (www.cat.pdx.edu/students).

If you encounter problems with your account(s), then email support@cat.pdx.edu or call 503-725-5420. If you have problems with a particular computer-based tool, consult your instructor or his/her T.A.

## *FAB security access and keys for ECE spaces*

To enter FAB outside the normal "open-door" hours, you need a PSU picture ID badge. Likewise, to access a special lab or a project workshop that is kept locked, you need the appropriate brass key. The steps to obtain these are as follows:

Building Access with ID Badge:

1. You need to get a PSU picture ID "badge" at window 9 in Neuberger Hall lobby. The PSU ID will have a "badge" number assigned and we need that number to allow after hours access to FAB.
2. Visit the CAT Team (FAB LL 82) or Amy Jolstead (FAB 160-07) and request "24/7" outdoor key access.
3. Within five business days, after hours door access to FAB will be available. Access is allowed through the Fourth Avenue and Harrison Street entrance by passing your PSU ID badge near the black square with keypad on the wall near the door.

Room Access with a Brass Key:

1. Pick up Key-Request form from the ECE office (FAB 160), fill it out, and return the form to the ECE office. Please provide information regarding the suite and room access requested and faculty that has authorized access.
2. REMOVE - no fee to pick up, just to replace. PSU cashier's office will bill your student account the required deposit(s). Currently this is $10 for each brass key. (Note: these deposits will be returned upon request, after you turn in your keys).
3. Within five business days, key(s) will be available the Facilities and Planning office on the Second floor of the University Services Building (USB 202: entrance on Montgomery between Sixth and Broadway). You will need to present a picture id to claim your key(s).

## *TA and RA Positions*

A limited number of graduate assistantships are available to well qualified applicants at both the Master's and Doctoral level. Teaching Assistantships are used to support the instructional programs in the department. Only in exceptional cases will the department award teaching assistantships to graduate candidates before they have successfully completed at least one quarter of ECE coursework at PSU. Chances of selection improve as a student establishes strong GPA credentials in ECE classes.

Research Assistantships in support of specific research programs are assigned by the Principal Investigator of the project. Candidates are often selected from the general applicant pool. Admission as a regular student, full-time enrollment, and good academic standing are prerequisites for receiving any assistantship.

### *Financial Aid*

US citizens and residents may receive consideration for financial assistance through the National Direct Student Loan, College Work-Study, the Guaranteed Federal Insured Student Loan Program, and the PLUS Program. More information can be obtained from the Portland State University Financial Aid Office. There is no financial assistance of this type available for International Students.

### *COOP Work Experience*

After completing a significant portion of their coursework, graduate students who are not already working in industry may choose to work part-time in local electronics and other companies to gain practical experience related to their. Up to 8 credits of supervised COOP work credits (ECE504) may be used as elective credits in the M.S. program or the M.Eng. program. COOP work of this type is paid.

## IV. ACADEMIC HONESTY POLICY

Academic honesty is a cornerstone of any meaningful education and a reflection of each student's maturity and integrity. The Office of Student Affairs is responsible for working with University faculty to address complaints of academic dishonesty.

The PSU Student Conduct Code, which applies to all students, prohibits all forms of academic cheating, fraud, and dishonesty. These acts include, but are not limited to, plagiarism, buying and selling of course assignments and research papers, performing academic assignments (including tests and examinations) for other persons, unauthorized disclosure and receipt of academic information, and other practices commonly understood to be academically dishonest. Allegations of academic dishonesty may be addressed by the instructor, may be referred to the Office of Student Affairs for action, or both. Allegations referred to the Office of Student Affairs are investigated following the procedures outlined in the Student Conduct Code.

Acts of academic dishonesty may result in one or more of the following sanctions: a failing grade on the exam or assignment for which the dishonesty occurred, disciplinary reprimand, disciplinary probation, loss of privileges, required community service, suspension from the University for a period of up to two years, and/or dismissal from the University.

## V. PROFESSIONAL ENGINEERING ETHICS

The ECE Department takes the issue of professional ethics very seriously. All students are expected to review follow the IEEE Code of Ethics, available at *http://www.ieee.org/membership_services/membership/ethics_code.html.*

# VI. GRADUATE CERTIFICATES OF SPECIALIZATION IN ELECTRICAL AND COMPUTER ENGINEERING

## *Program Overview*

The certificate programs are intended primarily to provide enrichment for professional engineers and scientists who may not initially wish to pursue a more extended M.Eng., M.S., or Ph.D. degree program. A Graduate Certificate of Specialization is awarded for successful completion of an approved course sequence relating to a specific area of Electrical and Computer Engineering. The courses within a sequence include a substantial body of knowledge at the graduate-level. Courses completed for a Graduate Certificate of Specialization may subsequently be applied towards a master's or doctoral degree program if and only if a student is admitted and completes a graduate certificate program prior to formal admission to a degree seeking program (i.e. M.Eng., M.S., or Ph.D.). All coursework is subject to adviser approval.

## *Admission Requirements*

Admission requirements for our certificate programs are the same as for our Master of Engineering (M.Eng.) program. Applicants who have completed a B.S. degree in either electrical or computer engineering at a recognized university (PSU Admissions Office maintains a list of recognized universities) with a grade point average of 3.00 or better in all junior and senior level technical courses may be considered for regular admission to the Department of Electrical and Computer Engineering's Graduate Certificate program. Applicants who have completed a B.S. degree in a related field (for example: mathematics, physics, computer science, or mechanical engineering, etc.) or B.S. ECE candidates with a grade point average in their upper-division technical coursework below 3.00 but higher than 2.75 may be granted conditional admission status. An applicant conditionally admitted to a certificate program must achieve a grade of B or better in the first eight graduate of courses applicable to the certificate and may also be required to complete prerequisite courses if appropriate educational background in the field is lacking. If either of the above conditions is not achieved, then the student will be dropped from the certificate program.

## *Certificate Requirements*

The total number of graduate level credits in a student's program must be at least 15, and some ECE certificates may require more than 15 credits or have additional requirements. A candidate for a Graduate Certificate of Specialization in Electrical and Computer Engineering must complete at least 12 graduate-level credits in ECE excluding all omnibus numbered courses (EE 501/601, 503/603, 504/604, 505/605, 506/606, 507/607) and transfer courses. Specific course requirements depend on the student's area of specialization, and the student's program must be approved by his/her academic adviser. Note: No transfer credit (credit from other institutions) is allowable for graduate certificates.

## *Specific Certificate Requirements*

### Analog and Microwave Circuit Design

Specific requirements for the Graduate Certificate in Analog and Microwave Circuit Design include the successful completion of four courses from the following list:

| | |
|---|---|
| ECE521 | Analog Integrated Circuit Design I |
| ECE522 | Analog Integrated Circuit Design II |
| ECE523 | Analog Integrated Circuit Design III |
| ECE531 | Microwave Circuit Design I |
| ECE532 | Microwave Circuit Design II |

### Communication Systems

Specific requirements for the certificate in Communication Systems include the successful completion of the following courses:

| | |
|---|---|
| ECE 561 | Communications Systems Design I |
| ECE 562 | Communications Systems Design II |

The student must also complete one course from the following list:

| | |
|---|---|
| ECE 518 | Linear System Analysis I |
| ECE 567 | Statistical Communications Theory |

or other ECE courses in Communication Systems. The student must take at least three additional credits in related areas.

### Computer Architecture and Design

The Certificate in Computer Architecture and Design requires completion of the following four classes. The prerequisite for this sequence is successful completion of the ECE 371 Microprocessors class or equivalent background.

| | |
|---|---|
| ECE 585 | Microprocessor System Design |
| ECE 586 | Computer Architecture |
| ECE 587 | Advanced Computer Architecture I |
| ECE 588 | Advanced Computer Architecture II |

A student considering this sequence might audit the ECE 371 class to prepare for the Certificate sequence.

**Design Automation**

Specific requirements for the certificate in Design Automation include successful completion of three courses from the following list:

| | |
|---|---|
| ECE 527 | High Performance Digital Systems |
| ECE 528 | Layout Techniques |
| ECE 529 | Performance-Driven Layout |
| ECE 572 | Advanced Logic Synthesis |
| ECE 573 | Control Unit Design |
| ECE 574 | High Level Synthesis and Design Automation |

or other ECE courses in Design Automation. The student must take at least three additional credits in related areas.

**Digital Design**

Specific requirements for the certificate in Digital Design include successful completion of three courses from the following list:

| | |
|---|---|
| ECE 573 | Control Unit Design |
| ECE 574 | High Level Synthesis and Design Automation |
| ECE 525 | Digital Integrated Circuit Design I |
| ECE 526 | Digital Integrated Circuit Design II |

or other ECE courses in Digital Design. The student must take at least three additional credits in related areas.

**Digital Signal Processing**

Specific requirements for the certificate in Digital Signal Processing include the successful completion of the three courses on the following list:

| | |
|---|---|
| ECE 565 | Signals and Noise |
| ECE 566 | Digital Signal Processing |
| ECE 567 | Statistical Communications Theory |

or other ECE courses in Digital Signal Processing. The student must take at least three additional credits in related areas.

**Image Processing**

Specific requirements for the certificate in Image Processing include the successful completion of the following courses:

| | |
|---|---|
| ECE 568 | Introductory Image Processing |
| ECE 569 | Advanced Image Processing |

The student must also complete one course from the following list:

| | |
|---|---|
| ECE 519 | Linear System Analysis II |
| ECE 570 | Computer Vision |
| ECE 578 | Intelligent Robotics I |
| ECE 579 | Intelligent Robotics II |

or other ECE courses in Image Processing. The student must take at least three additional credits in related areas.

**Integrated Circuit Test, Verification, and Validation**

Specific requirements for the certificate in Integrated Circuit Test, Verification, and Validation include the successful completion of three courses from the following list:

| | |
|---|---|
| ECE 525 | Digital Integrated Circuit Design I |
| ECE 526 | Digital Integrated Circuit Design II |
| ECE 528 | VLSI Computer-Aided Design |
| ECE 572 | Advanced Logic Synthesis |
| ECE 582 | Formal Verification of Hardware/Software Systems |

or other ECE courses in Integrated Circuit Test, Verification, and Validation. The student must take at least three additional credits in statistics or design of experiments such as the following:

| | |
|---|---|
| ECE 557 | Engineering Data Analysis and Modeling |
| ME 588 | Design of Industrial Experiments |
| STAT 564 | Applied Regression Analysis |

# VII. DEGREE REQUIREMENTS

The ECE Department offers a variety of graduate level programs with specific requirements detailed below.

Lecture courses taken under the undifferentiated grading option (P/NP) shall not be used to satisfy any graduate degree program requirements.

## *Graduate Certificate in Specialization*

Please review The Graduate Certificate in Specialization Handbook for program requirements. This handbook is located within the Graduate section of the website (ece.pdx.edu) and at the ECE front office.

## *General Restrictions for Master's degree programs*

- All classes used to satisfy ECE lecture credit requirements must be completed with a B- or better (effective for coursework completed Summer 2007 and thereafter).

- Students may not register for ECE 507 unless they are formally admitted to a master's degree program.

## *Master of Engineering (M.Eng.) Degree in Electrical and Computer Engineering*

All students are required to complete a tentative degree study plan that has been approved by the adviser no later than the second quarter of residence at PSU. The M.Eng. degree study plan form for this purpose is available in the ECE Department Office. Coursework taken without adviser approval may not be accepted as part of the student's program.

A minimum of 45 graduate credits are required. In addition to the University's degree requirements, a candidate for the M.Eng. degree must have 36 graduate-level lecture credits in electrical and computer engineering. Additionally, 9 credits of approved electives that may include transfer credits and credits from other allied disciplines. Note: no more than 3 credits of ECE 507 Graduate Seminar can be applied to a MEng degree.

## *Master of Science (M.S.) Degree in Electrical and Computer Engineering*

The Master of Science (M.S) program consists of two options. The first option involves a total of 45 credits, including 9 credits of thesis, 24 credits of ECE graduate lecture coursework, and 12 credits of elective graduate courses. The second option requires completion of a total of 45 credits, including 36 credits of ECE graduate lecture coursework, 9 credits of graduate electives and passing a comprehensive examination covering three distinct ECE topic areas.

Specific course requirements depend on the student's area of emphasis, and the student's program must be approved by his/her academic adviser. All students are required to complete tentative degree plan that has been approved by the adviser no later than the second quarter of residence at PSU. The M.S. degree study plan form for this purpose is available in the ECE Department Office. Coursework taken without adviser approval may not be accepted as part of the student's program. Note: no more than 3 credits of ECE 507 Graduate Seminar can be applied to an MS degree.

### ***Thesis option***

The candidate's program must include 9 thesis credits and a final oral thesis defense. The defense is public, and its schedule must be posted in the Electrical and Computer Engineering Department at least two weeks in advance.

If a student elects not to complete the thesis program, then they may petition the ECE Department to convert ECE 503 Thesis credits to ECE 501 Research credits. The conversion is NOT automatic. The conversion will be done if and only if a formal request is made to the ECE Graduate Committee and the request is approved.

A student must formally request the conversion in writing. The application for credit conversion must contain the following:

(a) Number of ECE 503 Thesis credits requested for conversion.

(b) Term(s) ECE 503 Thesis credits, requested for conversion, taken.

(c) Provide a detailed description of 1-2 paragraphs describing the work that was done when those ECE 503 Thesis credits were taken (A sentence is not sufficient. A minimum of one paragraph is required).

(d) A signature of endorsement from the student's faculty adviser.

In addition to the above requirements, the conversion request must also comply with the policies of the Office of Graduate Studies:

1) No credits will be converted unless the change is necessary for graduation.

2) No credits will be converted that are over two years old.

3) A maximum of 12 credits of 503 Thesis can be converted to 501 Research and applied to a master's program. (Twelve is the maximum number of 501 Research, 502 Independent Study, and 505 Reading & Conference combined which can be applied to a 45 credit degree.).

4) Any 503 Thesis credits not converted will remain on the student's transcript with a grade of "In Progress" to reflect that a thesis was pursued although not completed.

The completed application should be submitted to the ECE office for processing. You will be informed of the final decision in writing.

A student either considering or wishing to convert ECE 503 Thesis credits to ECE 501 Research credits should meet with their faculty adviser immediately.

***Comprehensive Exam option***

A student in the M.S. with comprehensive exam option must pass a written examination covering three distinct ECE topic areas. The comprehensive exam will be administered by the ECE Department.

Technical Areas of the Comprehensive Exam are listed on the application form.

Comprehensive Exam Format

1. The graduate committee constructs a list of typically between 8 to 10 technical areas for evaluation. This list is posted and remains in effect unless changed by a faculty vote.
2. The student chooses three technical areas, which constitutes the comprehensive exam. All three areas are tested on the same day.
3. Each technical area is evaluated with a written exam constructed by the appropriate technical area committee.

4. A student will have two hours to complete a technical area exam.
5. The comprehensive exam is administered by the ECE graduate program director on a Saturday during the fall quarter and on a Saturday during the spring quarter. The exam is ***not*** offered during the winter quarter.
6. The appropriate area committee is responsible for grading the exam. Grades are P/NP.
7. A student must receive a P in all three technical area exams to receive a P for the comprehensive exam.

A student who fails the comprehensive exam the first time is permitted a second attempt. Students failing the second attempt are immediately dropped from the ECE graduate program. In particular, students failing the second attempt are prohibited from transferring to the M.S. Thesis or M.Eng. degree programs.

Students in the existing Master of Engineering degree program and the M.S. degree with thesis option can transfer to the M.S. degree with comprehensive exam option. Students transferring from the M.S. thesis program to M.S. degree with exam option program may request to convert ECE 503 (Thesis) credits into ECE 501 (Research) credits if approved by the ECE department and subject to the limitations and conditions imposed by the Office of Graduate Studies. Note: no more than 3 credits of ECE 507 Graduate Seminar can be applied to an MS degree.

## *Doctoral Degree (Ph.D.) in Electrical and Computer Engineering*

In addition to the University doctoral degree requirements listed in the PSU Bulletin, a candidate for the Ph.D. degree in electrical and computer engineering must complete a minimum of 80 graduate credits, consisting of at least 45 ECE graduate credits, 8 elective graduate course credits and at least 27 credits of ECE 603 (dissertation). Of the 45 ECE credits, 32 credits must come from ECE lecture courses (24 lecture credits if the student successfully completed an ECE MS Thesis). The 8 elective credits may come from any academic department, but must be lecture credits only. One additional graduate credit is required to meet the University specified minimum total of 81 credits for a Ph.D.

Each Ph.D. must have at least one journal publication. Specific course requirements depend on the student's area of emphasis, and the student's program must be approved by his/her academic adviser. Students in the Ph.D. program in Electrical and Computer Engineering are required to pass a comprehensive examination (written or oral) after completing a substantial amount of coursework. They are also required to obtain approval of their proposed research plan by their doctoral committee before they can be advanced to candidacy. A dissertation containing a real contribution to knowledge based on the candidate's own investigation and a final oral dissertation defense are required. The dissertation must show a mastery of the literature of the subject and be written in credible literary form. The defense is public and its schedule must be posted in the Electrical and Computer Engineering Department at least two weeks in advance.

Lecture courses taken under the undifferentiated grading option (P/NP) shall not be used to satisfy any graduate degree program requirements. All coursework must be completed with a grade of B- or better.

***Check List for Ph.D. Degree Requirements:***

(1) Meet with Graduate Program Director
(2) Appointment of the Advisory Committee (ECE-PhD-1)
(3) Study Plan (ECE-PhD-2) Approved by the Advisory Committee
(4) Comprehensive Exam Passed (ECE-PhD-3)
(5) Doctoral Dissertation Committee Approved (GO-16D)
(6) Residency requirement
(7) Dissertation Proposal Approved (ECE-PhD-4)
(8) Advancement to Candidacy
(9) Minimum of 3 years beyond BS degree
(10) Journal Publication Requirement
(11) Final Oral examination – Dissertation Defense (GO-17D)

## *Doctoral Degree Timeline*

***Study Plan Approved by the Advisory Committee***

Students are required to complete a tentative degree plan that has been approved by their advisory committee not later than the second quarter of their residence at PSU. A Ph.D. Study Plan form for this purpose is available in the Electrical and Computer Engineering Department Office. Coursework taken without adviser approval may not be accepted as part of a student's program.

***Comprehensive Exam***

All Ph.D. students must pass the ECE department comprehensive exam. Two attempts are allowed. The first attempt must be made within 18 months after matriculation. If necessary, then a second attempt may be allowed no sooner than 30 days after the first attempt but no later than 24 months after formal admission to the PhD program. Failure to comply with this requirement and its deadlines will result in automatic dismissal from the Ph.D. program.

The PhD comprehensive exam will be administered by the student's PhD advisory committee.

The comprehensive exam format shall be determined by the student's PhD advisory committee. The exam must evaluate the student in not less than two distinct technical areas that are closely related to the student's dissertation topic. The PhD advisory committee may include additional technical topic areas on the exam. The advisory committee shall inform the student, in writing, of the format and technical areas that will be evaluated not less than 30 days prior to the exam date.

***Dissertation Proposal***

All Ph.D. students must successful present a proposal of the dissertation subject to an approved dissertation committee. Two attempts are allowed. The first attempt must be made within 24 months after passing the comprehensive examination. If necessary, a second attempt must be made within 30 months of passing the comprehensive exam. A student who does not pass after the first attempt must wait at least 90 days before the second attempt. Under no circumstances may a student take the exam more than two times. This rule applies even if the faculty adviser or dissertation committee members change. Failure to comply with this requirement and its deadlines will result in automatic dismissal from the Ph.D. program.

NOTE: NO PROPOSAL DEFENSE SHALL BE VALID WITHOUT A DISSERTATION COMMITTEE APPROVED BY THE OFFICE OF GRADUATE STUDIES. Note: a completed GO-16D Appointment of Doctoral Dissertation Committee must be submitted to the ECE Department at least six weeks prior to the tentative proposal date. The PhD dissertation committee must consist of not less than three ECE faculty members, all of which must hold tenure/tenure-track faculty appointments in the ECE department equal or greater than 0.5 FTE. The committee chair must hold an ECE tenure/tenure-track faculty appointment.

Not less than two weeks prior to the date of the exam the student shall give each dissertation committee member a written proposal describing the research topic of the PhD dissertation. This written proposal submitted to the committee for approval should be sufficiently detailed and clear to provide a blueprint for the study to follow. The proposal is expected to include the following:

1. General nature and present status of knowledge of the problem.
2. The theoretical and empirical framework within which the proposed problem exists.
3. The significance of the proposed research and its likely contributions.
4. The research methodology to be used.
5. A timeline for conducting the research and completion of the dissertation

The committee will have at least two weeks to read a student's written proposal and make a decision if the student is ready for the exam. The exam can be postponed to allow the student make improvements indicated by the Ph.D. dissertation committee members.

The exam itself begins with an oral presentation by the student describing the proposed research effort, which will be the topic of the PhD dissertation. The dissertation committee may ask the student questions about the oral presentation, the written proposal or any questions necessary to determine if the student has a sufficient background and preparation necessary to conduct the research. The exam shall not exceed three hours.

***Advancement to Candidacy***

Once the dissertation proposal is approved, the student will be advanced to candidacy. A doctoral candidate has a minimum of four months and a maximum of five years from the effective date of advancement to candidacy to complete all requirements for graduation. Please see "Graduate Studies" section of the PSU Bulletin for more details.

## *Areas of Emphasis*

The department offers various topics for study. Below is a collection of courses that fit within specific areas of emphasis. These areas of emphasis are recommendations only. Students are encouraged to review these areas of emphasis when creating a study plan. Be advised that all students must obtain approval from their faculty adviser prior to enrolling in any graduate course.

### *Analog Design*

| | |
|---|---|
| ECE 521 | Analog Integrated Circuit Design I |
| ECE 522 | Analog Integrated Circuit Design II |
| ECE 523 | Analog Integrated Circuit Design III |

### *Communication Systems*

| | |
|---|---|
| ECE 561 / 661 | Communication Systems Design I |
| ECE 562 / 662 | Communication Systems Design II |
| ECE 567 / 667 | Statistical Communications Theory |

### *Computational Intelligence*

| | |
|---|---|
| ECE 555 | AI: Neural Networks I |
| ECE 556 | AI: Neural Networks II |
| ECE 559 | Genetic Algorithms |

### *Computer Architecture and Design*

| | |
|---|---|
| ECE 585 | Microprocessor System Design |
| ECE 586 | Computer Architecture |
| ECE 587 | Advanced Computer Architecture I |
| ECE 588 | Advanced Computer Architecture II |

### *Control Systems*

| | |
|---|---|
| ECE 551 | Control Systems Design I |
| ECE 552 | Control Systems Design II |
| ECE 553 / 653 | Control Systems Design III |

### *Digital Design*

| | |
|---|---|
| ECE 573 | Control Unit Design |
| ECE 574 | High Level Synthesis and Design Automation |
| ECE 525 | Digital Integrated Circuit Design I |
| ECE 526 | Digital Integrated Circuit Design II |
| ECE 581 | ASIC Design: Modeling & Synthesis |
| ECE 583 | Low Power Digital IC Design |

***Electromagnetics / Acoustics***

| | |
|---|---|
| ECE 531 | Microwave Circuit Design I |
| ECE 532 | Microwave Circuit Design II |
| ECE 533 | Advanced Electromagnetics |
| ECE 534 | Acoustics |
| ECE 576 | Computational Methods in Electrical Engineering |

***Embedded Systems***

| | |
|---|---|
| ECE 530 | Fault Tolerant Systems |
| ECE 510 | Co-Design & System Level Synthesis |
| ECE 582 | Formal Verification of Hardware / Software Systems |
| ECE 590 | Digital Design Using HDLs |

***Energy Systems***

| | |
|---|---|
| ECE 541 | Transmission Operation & Control |
| ECE 542 | Generation Operation and Control |
| ECE 547 | Energy Economic Systems |
| ECE 548 | Power System Protection |
| ECE 641 | Power System Planning |
| ECE 642 | Energy Systems Capital Budgeting |
| ECE 643 | Sustainable Energy Systems (formerly Alt. Energy) |

***IC Test, Verification and Validation***

| | |
|---|---|
| ECE 525 | Digital Integrated Circuit Design I |
| ECE 526 | Digital Integrated Circuit Design II |
| ECE 527 | High Performance Digital Systems |
| ECE 572 | Advanced Logic Synthesis |
| ECE 575 | Introduction to IC Test |
| ECE 582 | Formal Verification of Hardware / Software Systems |

***Image Processing***

| | |
|---|---|
| ECE 568 / 668 | Introductory Image Processing |
| ECE 569 / 669 | Advanced Image Processing |
| ECE 570 / 670 | Computer Vision |

***Linear Systems***

| | |
|---|---|
| ECE 518 | Linear System Analysis I |
| ECE 519 | Linear System Analysis II |
| ECE 569 / 669 | Advanced Image Processing |

***Microelectronics***

ECE 514 Microsystem Integration and Packaging
ECE 515 Fundamentals of Semiconductor Devices
ECE 516 Integrated Circuit (IC) Technologies
ECE 517 Nanoelectronics

***Signal Processing***

ECE 569 / 669 Advanced Image Processing
ECE 566 / 666 Digital Signal Processing
ECE 538 / 638 Statistical Signal Processing

***Solid State Electronics***

ECE 515 Fundamentals of Semiconductor Devices
ECE 516 Integrated Circuit Technologies
ECE 511 Solid State Electronics I
ECE 512 Solid State Electronics II
ECE 513 Solid State Electronics III

## *Transfer Credits*

Within program constraints, up to one third of the credits required for an M.Eng. or M.S. degree may be transferred from other institutions with Adviser and Departmental approval. After gaining approval from your adviser for a specific course or courses, you will need to complete a GO-21 form obtained from the Office of Graduate Studies website.

# VIII. DEGREE COMPLETION PROCESS

Theses and dissertations are submitted electronically to the Office of Graduate studies. See *http://www.gsr.pdx.edu/ogs_ETD.php* for specific submission instructions. There is also information on that website about defending your thesis or dissertation.

There are several documents that must be processed before you can be awarded your degree. The ECE department will submit these forms, but is up to you and your adviser to insure the forms are properly filled out and submitted on time. See *http://www.gsr.pdx.edu/ogs_general_deadlines.php* for a listing of these forms and their associated deadlines.

# IX. ACADEMIC STANDING POLICY

## *Academic Probation*

All students admitted to graduate studies (regular, conditional, and graduate certificate) at Portland State University must maintain a GPA of at least 3.00 for all graduate credit earned at Portland State University. An admitted student is placed on probation if:

1. The student's cumulative graduate GPA at Portland State University, based on the completion of 9 graded graduate credits at Portland State University, is below 3.00 at the end of any term; or
2. The student's term graduate GPA, based on a minimum of 6 graded graduate hours, is below 2.67 for a given term.

While on academic probation the student will not be permitted to graduate, to be advanced to doctoral candidacy, to receive approval of the masters degree program (GO-12 form), to receive or continue to hold a graduate assistantship, or to register for more than a total of 9 credit hours in any term. Removal of academic probation occurs if the cumulative graduate GPA is brought to 3.00 within the next 9 graduate credits in graded courses in the case of probation due to a low cumulative GPA, or both cumulative and term GPA of 3.00 or above in the case of probation due to a low term GPA.

## *Disqualification*

A student who is disqualified may not register for any graduate courses at PSU for at least one calendar year. Disqualification occurs if:

1. The student on academic probation for low GPA fails to achieve a cumulative graduate GPA of 3.00 or higher within the next 9 graduate credits in graded courses; or
2. The student on probation for a term GPA of below 2.67 does not receive at least a 3.00 term GPA, and does not achieve a 3.00 cumulative GPA with the next 9 graded graduate hours, if applicable; or
3. The student becomes subject to academic probation for a second time.

## *Readmission after Disqualification*

A disqualified student may petition for re-admission as a degree-seeking student in a graduate program after one calendar year. Re-admission after the mandatory one-year period is initiated by the student's filing of a petition for re-admission to the Graduate Council through the Office of Graduate Studies and Research. Re-admission is not automatic. To be readmitted the student must meet all current admission requirements with the exception of the graduate GPA.
If the student's graduate program has recommended re-admission, the Graduate Council may grant re-admission, with or without additional academic requirements, or may recommend

continued disqualification. The readmitted graduate student is subject to all University and program requirements in effect at the time of readmission. The student must raise the PSU cumulative graduate GPA to 3.00 or better with 12 credits of graded graduate coursework after re-admission, or she/he will be disqualified.

Graduate courses completed at other institutions while a student is under disqualification at PSU will not be applied toward a graduate program at PSU.

### *Leave Of Absence*

A student in good academic standing may petition for a leave of absence of up to one year. The leave of absence status ensures the student will not be dropped from the program during an extended absence. Students formally apply for a leave of absence, in writing, to the Chair of the ECE department graduate committee. The application must state the dates of absence and the reason why the leave is requested. Any supporting documentation should be included.

A student may petition for a second leave of absence from a graduate program, but approval is required from the department chair and graduate committee of the college or school. Any student who requests a leave of absence for a non-health related reason must provide supporting evidence that the situation prompting this request will not be repeated. The student must also present a work plan after coming back from the leave of absence. Applications submitted without this information will be returned without action.

NOTE: A leave of absence will delay any ECE department degree deadlines but it does not constitute a waiver of the time limit for completion of a PSU graduate degree. Moreover, while on a leave of absence the student is prohibited from using any university resources that could contribute to completion of a degree. This prohibition includes, but is not limited to, access to the university library, CECS computer accounts and the student's faculty advisor, advisory committee members or thesis/dissertation members.

## X. APPEAL PROCEDURE

If a student wishes to appeal a departmental decision then a formal request must be made, in writing, within 60 day of notification (also see section “XI. Readmission Policy” if applicable). To appeal an ECE Department decision, a student must submit an appeal packet to the ECE graduate committee chair. The appeal packet must consist of the following:

1. A statement identifying which decision should be overturned.
2. A statement explaining why the prior decision should be overturned (include any supporting documentation).
3. A letter of support from the student's faculty adviser recommending the prior decision to be overturned.

An incomplete appeal packet will be returned without action.

The ECE graduate committee will review the appeal packet and make a recommendation to the ECE graduate program director who will then render a final decision. The student will be informed of the final decision in writing.

Not all decisions can be appealed. Students must check with ECE graduate program staff prior to submitting an appeal packet (email: graduate.program@ece.pdx.edu or phone 503.725.3002).

# XI. READMISSION POLICY

I. Scope

This policy describes the ECE department requirements for applying for readmission to an ECE department graduate program.

II. Application

In this policy the phrase “graduate program” refers to a master’s degree program, a doctoral program or a graduate certificate program in the ECE department. Furthermore, the term “drop date” refers to the date the ECE department dropped the student from their degree program. This policy applies to all students who were previously admitted to an ECE department graduate degree program or graduate certificate program, matriculated, and then were subsequently dropped from their ECE graduate program for any reason other than misconduct. Students removed for misconduct shall have their applications for readmission returned without action.

III. Requirements

Students dropped from any ECE department graduate program must reapply within 12 months after the drop date. Any readmission application received more than 12 months from the drop date will be returned without action. Students must also comply with any university requirements for readmission.

The readmission application packet must contain the following:

1. A statement describing why the student was dropped from the graduate program.
2. A statement explaining why the conditions that lead to removal from graduate program no longer exist. Include any supporting documentation.
3. Transcripts from any graduate coursework taken since being dropped from the ECE graduate program.
4. A list of all graduate program requirements remaining before graduation.
5. A plan showing when the remaining graduate program requirements are scheduled to be completed.
6. A letter from the student’s faculty adviser supporting the readmission request.

The readmission packet shall be submitted to the ECE graduate program director for review. The readmission must be approved by the ECE department graduate committee.

## XII. ECE Faculty

For a detailed description of Faculty publications and areas of research please go to the Department web page at: www.ece.pdx.edu

## XIII. GRADUATE COURSE DESCRIPTIONS

For current graduate course descriptions, please go to the Department web page at: http://www.ece.pdx.edu/Courses/Courses.php#Grad

## XIV. CONTACT INFORMATION

**Admissions and Records Office** **503.725.3511**
Neuberger Hall Lobby (NH)
Domestic: admissions@pdx.edu www.pdx.edu/admissions/graduate.html
International: intladm@pdx.edu.

**Maseeh College of Engineering and Computer Science** **503.725.4631**
Engineering Building, Dean's Office (EB 500)
info@cecs.pdx.edu www.pdx.edu/cecs

**Computer Action Team** **503.725.5420**
Fourth Avenue Building (FAB 82-01)
support@cat.pdx.edu www.cat.pdx.edu

**Electrical and Computer Engineering Department** **503.725.3002**
Fourth Avenue Building, Suite 160 (FAB 160)
graduate.program@ece.pdx.edu www.ece.pdx.edu

**Financial Aid Office** **503.725.3461**
Neuberger Hall Lobby (NH)
askfa@pdx.edu www.pdx.edu/finaid

**Graduate Studies & Research Office** **503.725.8410**
184 Extended Studies Building (XSB), 1633 SW Park Ave
grad@pdx.edu www.pdx.edu/ogs

**International Student & Faculty Services** **503.725.4094**
East Hall, Room 101 (EH 101) www.pdx.edu/intl