

# ECE PhD Summary

Department of Electrical and Computer Engineering  
Purdue School of Engineering and Technology  
Indiana Univ. Purdue Univ. Indianapolis

## Points of contact

The points of contact for the ECE Graduate program

**Head of the graduate program:** The chair of the department is the head of the graduate program. The chair will ensure that ECE Graduate Programs policies & rules are implemented. The chair will also ensure that all graduate student receive faculty advising. Typically the chair is the initial adviser.

**ECE Graduate Committee** The ECE Graduate Committee is responsible for establishing policies, rules and guidelines for the ECE graduate programs program.

**Faculty mentors** The faculty mentors (dissertation advisors) are responsible for directing the PhD student research. Advising and mentoring them.

**ECE Graduate Program coordinator:** ECE Graduate Program coordinator is responsible for coordinating admissions, as well as administering program requirements.

## PhD Degree Requirements

### Credit Hours Required/Time To Completion

The Ph.D. program requires 90 credit hours for completion. The requirements outlined address students who were admitted to the PhD program after having completed a Masters degree, as well as students admitted directly after their undergraduate program (called *Direct Admits*). At any time when requirements for PhD students with Masters degrees differs with requirements for PhD students who are Direct Admits, then the difference will be indicated clearly. The ECE Ph.D. program at Indiana University Purdue University Indianapolis will primarily focus on five areas. The five areas in the ECE program at IUPUI consist of:

- Automatic Control (AC)
- Power and energy (PE)
- Communications/Signal Processing (CS)
- Computer Engineering (CE)
- VLSI and Circuit Design (VC)

Students will choose a primary area from the above list. A minimum of 39 graduate course credit hours (non-thesis credit hours) are needed to fulfill the course requirements of the program. Course selection must satisfy

- PhD students who are Direct Admits must complete at least 2 ECE core courses, one of which is in their primary area (see Table 1), These core course requirements can only be satisfied by completing the courses at IUPUI or PUWL<sup>1</sup>

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<sup>1</sup>See Section ?? concerning transfer credit requirements

- PhD Students admitted to the PhD program with a Masters degree must complete the core course in their primary area (or an equivalent course)<sup>2</sup>
- PhD students must complete 2 ECE courses (non-core) numbered 61100 or higher, and
- PhD students must complete at least 18 graduate credit hours from the students primary area <sup>3</sup>.
- PhD students must complete 2 graduate mathematic content courses and 3 related area courses; or 3 graduate mathematic content courses and 2 related area courses <sup>4</sup>. (See Section ?? for list of mathematic content courses)
- PhD students must complete ECE 69401 seminar course (within their first year) with a satisfactory grade
- The remaining credit hours will be satisfied by completing credit hours in ECE 69900.
- PhD students must be enrolled in a research credit hour course each semester they are enrolled.
- PhD students must maintain progress towards their degree as defined by the ECE Graduate committee

The above requirements are summarized in Table 2 and Table 3 below. In addition to these requirements, ECE 69600 (Advanced Projects) can not to appear on the Ph.D. plan of study and cannot be used to fulfill any of the Ph.D. requirements. Core course requirements for direct Ph.D. admits can only be satisfied by taking the courses at IUPUI PUWL.

Table 1: Areas within ECE PhD Program

Primary Area	Acronym	Core Courses
Automatic Control	AC	ECE 60200
Communications/Signal Processing	CS	ECE 60000
Computer Engineering	CE	ECE 60800
VLSI and Circuit Design	VC	ECE 60600 or ECE 60800
Power and energy	PE	ECE 61000

### PhD Students who are direct admits to PhD program

PhD Students who are direct admits to PhD program must satisfy the following

Table 2: Summary of Ph.D. credit hour requirements for direct admits

Minimum Number of credit hours	90
Minimum number of graduate courses credit hours in ECE	39
Minimum number of Core courses credit hours	6
Minimum number of credit hours in primary area	18**
Minimum number of ECE courses credit hours $\geq$ 61100	6

### PhD Students who were admitted to the PhD program with a Masters degree

Students enrolled in the Ph.D. program after the completion of a Masters degree may be able to apply some of their Masters degree course credits toward the Ph.D. degree. Evaluation of eligible Masters credit hours will be conducted on a case-by-case basis by the Head of the ECE Graduate Program (department chair) in consultation with the ECE Graduate Committee. A summary of the requirements in this case is shown in Table 3.

PhD Students who were admitted to the PhD program with a Masters degree satisfy the following

Table 3: Summary of Ph.D. credit hour requirements for student who enroll with masters degree

Minimum Number of credit hours	90*
Minimum number of graduate credit hours in primary area	18
Must have taken core course or equivalent in primary area	3
Minimum number of course credit hours taken after MS degree	18**
Minimum number of ECE course credit hours $\zeta=61100$ taken after MS degree	6

\*based on case-by-case evaluation, credits hours from of the Master degree may be applied towards the Ph.D. degree

Full-time status requires enrollment in 8 credit hours per semester (fall and spring). Students who are employed 16-20 hours per week on a Student Academic Appointment are required to enroll in a minimum of 6 credit hours per semester to maintain full-time status. Typically, Ph.D. students enroll in 6-10 credit hours (combined coursework and/or research credits) up through the semester in which they complete their coursework and pass qualifying examinations. Once the student has completed all coursework, enrollment in nine-to-twelve ECE 69900 research credit hours per semester is typical. A Ph.D. student should be able to complete the program in 4- 5 years (8-10 semesters).

### Other requirements

**Graduate Seminar Requirement** All ECE graduate students must satisfactorily complete one semester of the ECE Seminar, ECE 69401. This course carries no credit, but a grade of Satisfactory or Unsatisfactory is assigned at the end of the semester. ECE 69401 should not be listed on the plan of study. Also, it is strongly recommended that students take ECE 69400 during their first year.

**Examination Requirements** The three major examinations that must be passed during the course of a PhD program are the Qualifying Examination (QE), the Preliminary Examination, and the Final Examination. The purpose of the QE is to verify that students have mastered fundamental area-related topics in the student's Primary and Related Areas at the core course level. The purpose of the Preliminary Examination is to determine whether a student is adequately prepared to conceive and undertake a suitable research topic. The Preliminary Examination typically includes an oral presentation and a written thesis proposal. The purpose of the Final Examination or oral defense of the dissertation is to determine if the thesis research warrants granting the PhD.

**English Requirement** All ECE graduate students must demonstrate acceptable proficiency in written English.

## Minimum Academic Standards

### ECE Department standards

As a PhD student in ECE, you are expected to achieve the following standards throughout your academic program:

- Maintain a grade point average of at least 3.30 out of 4.00 over all graduate courses taken.
- Must maintain 3.30 on on your plan of study, with no grade less than "C-"
- Earn grades of "Satisfactory" in thesis research credit hours;
- in the case of direct admit (admission to the PhD program without masters degree). Grades earned to satisfy core course requirement must be C or better and the average of the two core courses must be C+ or higher.
- Satisfactorily complete the ECE 69401 seminar and the written English proficiency requirement within the first two semesters of your academic program;
- Make continuous and significant progress each semester toward completion of your degree requirements; and

<sup>2</sup>The equivalent course must be determined by ECE Graduate program and may be satisfied at another university

<sup>3</sup>courses in their masters degree can be counted towards this requirement.

<sup>4</sup>courses in their masters degree can be counted towards this requirement.

- Complete all degree requirements and graduate within the deadlines described by ECE Graduate Committee.

You will be placed on ECE academic probation if you complete any semester or summer session with a deficiency in any of the above standards. Should you remain on ECE academic probation at the end of the succeeding semester or summer session, and at the discretion of the ECE chair, you may be prohibited from registering for further graduate study. Students concerned about their academic progress should schedule an appointment with the ECE chair.

The cumulative POS grade point average referred to above is calculated using the courses on the PhD plan of study, excluding courses taken as part of the Masters program. However, transfer courses and graduate-level courses taken while an undergraduate student are not included in the computation. In the case of a deficiency in the cumulative POS grade point average, courses may be repeated. If a course is repeated, only the most recent grade received will be used in computing the index. University requirements state that no grade of “D+” or lower is allowed in a course on the plan of study. On any approved plan of study, a course in which a grade of “D+” or lower is received then it must be repeated and completed successfully; it cannot be dropped from the plan of study.

## **Advisory Committee**

### **Academic Advisory Committee**

Your Academic Advisory Committee is to provide advice on your choice of courses on the Preliminary Plan of study. Your Academic Advisory Committee consists of the three Electrical and Computer Engineering faculty members (or ECE adjunct faculty<sup>5</sup>) who sign your Preliminary Plan of study. The Major Professor need not be indicated on the Preliminary Plan of study. The Academic Advisory Committee serves until you have selected a Major Professor and Doctoral Advisory Committee. The two advisory committees need not be the same.

### **Doctoral Advisory Committee**

The Doctoral Advisory Committee consists of at least four members. The primary duties of this committee are to assist in the preparation of the student’s final plan of study, to advise the student during the course of their thesis research, and to conduct the Preliminary and Final Examinations. The Major Professor serves as chairperson of the Doctoral Advisory Committee (in cases where there are two professors leading the research, co-chairs can be used). In most cases, the Major Professor and the student choose the Related Areas and the other members who will serve with the Major Professor on the Doctoral Advisory Committee. Membership of the committee must satisfy:

- The chairperson and at least two other members must be IUPUI ECE faculty members
- The chairperson and at least one other member should be members of the Primary Area that the student has declared.
- If two advisors guide a student’s research jointly, then it is possible to have two co-chairs on Doctoral advisory committee rather than a single chair. At least one of the co-chairs must be a member of the IUPUI ECE faculty and should be a member of the Primary Area that the student has declared.

### **Transfer credits**

Questions concerning the possible transfer of course credits should be directed to ECE chair Brian King

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<sup>5</sup>at most one of the three can be adjunct

## Graduate Courses for the Primary Area

The list below was revised on December 2017. An up-to-date graduate course list is available on the ECE Graduate website. Note the following abbreviation for primary areas: Automatic Control, Robotics and System (AC); Communication and Signal Processing (CS); Computer Engineering (CE); Power and energy (PE); and VLSI and Circuit Design (VC).

Course Number/Title	AC/PE	CS	CE	VC	Semester Offered <sup>6</sup>
ECE 510 Introduction to Biometrics		V	V		Infrequent
ECE 52601 Nanosystem Principles				V	Fall
ECE 532 Computational Methods for Power System Analysis	V				Spring
ECE 53301 Wireless and Multimedia Computing		V	V		Fall
ECE 537 Multimedia Applications		V	V		Fall
ECE 538 Digital Signal Processing I		V	V		Fall 2017
ECE 53801 Intro. to Discrete Event Dynamic Sys.	V				Fall 2017
ECE 53900 Foundations of Adv. Eng. I		V	V		Summer even years
ECE 544 Introduction to Digital Communications		V			Spring 2019
ECE 547 Introduction to Computer Communication Networks		V	V		Fall
ECE 54800 Intro. to 2D & 3D Image Proc.		V			Spring 2019
ECE 554 Electronic Instrumentation and Control Circuits				V	summer 2018
ECE 559 MOS VLSI Design				V	Fall odd year
ECE 56401 Computer Security			V		Fall 2017
ECE 565 Computer Architecture			V		Spring
ECE 56601 Real-Time Operating Systems and Applications			V		Fall 2017
ECE 569 Introduction to Robotics	V				Fall
ECE 570 Artificial Intelligence			V		Fall
ECE 57101 MODELING/DESIGN-SMART DEVICES		V	V		Fall 2017
ECE 580 Optimization Methods for Systems and Control	V				Spring
ECE 595 Automotive Control	V				Unavailable
ECE 595 Design with Embedded and Digital Signal Processors		V	V		Spring
ECE 595 Architecture and Computing Trends in Parallel and Distributed Systems			V		Spring
ECE 595 Machine learning & statistical signal proc.		V			Spring 2018
ECE 595 Integrated Nanosystem Processes & Device				V	Spring
ECE 595 Adv. Power Converters	V				Spring
ECE 595 Smart Grid	V				Summer 2018
ECE 595 Medical Image Analysis		V			unavailable
ECE 600 Random Variables and Signals		V			Fall
ECE 602 Lumped System Theory	V				Spring
ECE 604 Electro Magnetic Field Theory				V	not offered
ECE 606 Solid-State Devices				V	not offered
ECE 608 Computational Models and Methods			V	V	Spring
ECE 610 Energy Conversion	V				Fall
ECE 627 Cryptography & Intro. to Secure Comm.		V	V		Fall even yrs.
ECE 637 Digital Image Processing I		V			to be announced
ECE 648 Wavelet, Time-Frequency, and Multirate Signal Processing		V			Unavailable
ECE 662 Pattern Recognition and Decision-Making Processes	V	V			Fall
ECE 680 Modern Automatic Control	V				Fall
ECE 684 Linear Multivariable Control	V				Fall 2018
ECE 685 Introduction to Robust Control	V				Infrequent
ECE 695 Mobile Wireless Networks		V	V		spring 2018
ECE 695 Error Control Coding		V	V		to be announced

*Unavailable*= courses are offered, but at the time this document was constructed, the tentative offering schedule could not be determined. Consult with your adviser and/or the Schedule of Classes.

*Infrequent*= courses are offered irregularly

Note: The above table represents a tentative frequency of courses offered. Students should rely on the current schedule of classes for courses offered in a given semester and should communicate with their advisers about potential changes in future years.

## Mathematics Requirement

The following list of courses have been approved for meeting the mathematics requirement.

### Mathematics Courses

Courses numbered MATH 511 and above are acceptable with the exceptions listed below:

1. MATH 519 (STAT 519) is *not* acceptable due to significant overlap with ECE 600
2. MATH 504 is acceptable for students whose primary area is either Automatic Controls or Communications and Signal Processing;
3. MATH 527 is *not* acceptable for Communications and Signal Processing majors.
4. Math education related courses are not acceptable.

### Electrical & Computer Engineering Courses

**ECE 539** Foundations of Advanced Engineering I

**ECE 580** Optimization Methods for Systems & Control

**ECE 695** Error Correction Codes (Error Control Coding)

### Computer Science Courses

**CSCI 514** Numerical Analysis

**CSCI 515** Numerical Analysis of Linear Systems

**CSCI 520** Computational Methods in Analysis

**CSCI 614** Numerical Solution of Ordinary Differential Equations

**CSCI 615** Numerical Solution of Partial Differential Equations

### Statistics Courses

**STAT 528** Introduction to Mathematical Statistics

**STAT 529** Applied Decision Theory and Bayesian Statistics

**STAT 532 (MATH 532)** Elements of Stochastic Processes

**STAT 533** Non-Parametric Statistics

**STAT 538 (MATH 538)** Probability Theory I

**STAT 539 (MATH 539)** Probability Theory II

**STAT 553** Theory of Linear Models and Experimental Designs

**STAT 554** Multivariate Test Statistics

**STAT 555** Non-Parametric Statistics

**STAT 576** Introduction to Statistical Decision Theory

**STAT 638 (MATH 638)** Stochastic Processes I

**STAT 639 (MATH 639)** Stochastic Processes II

**STAT 657** Theory of Tests, Estimation and Decisions I

**STAT 658** Theory of Tests, Estimation and Decisions II

**STAT 667** Measure-Theoretic Statistics: Decision Theoretic and Classical

**STAT 668** Asymptotic Distribution Theory

### Physics Courses

**PHYS 600** Methods of Theoretical Physics I

**PHYS 601** Methods of Theoretical Physics II

Please Note: Faculty-initiated requests for changes or exceptions to the above will be considered by the Graduate Committee after approval by the appropriate area. Student-initiated requests must follow the same procedure, with the additional first step of approval by the student's major adviser.