Degree Requirements

Doctor of Philosophy (Ph.D.) Program

Students entering the program with a B.S. will follow the coursework requirements for the B.S. to Ph.D. Degree Plan while those entering with an M.S. will follow the M.S. to Ph.D. Degree Plan. The remaining requirements are identical for both programs.

1. Coursework for the B.S. to Ph.D. Degree Plan
   - All supported students must enroll in the ECE department's seminar course (ECE 6011, or 6111) every semester for the duration of their program.
   - All structured coursework must follow the Appropriate Coursework Standards.
   - At least 84 semester hours of graduate credit beyond the BS, with at least 33 hours in structured course work, and at least 27 hours of research (ECE8x98) and 12 hours of dissertation (ECE8399). The remaining 12 hours may consist of structured course work or research.
   - Additionally,
     - All of the structured coursework must be at the 6000 level or higher.
     - At least 21 of the 33 hours of structured course work must be in ECE courses.
     - Non-ECE courses used to satisfy the structured course requirement must be related to the field of study and be approved by the student’s advisor.
     - If structured coursework is chosen for the remaining 12 hours, the courses may be chosen from inside ECE or outside ECE.
     - Non-ECE courses must be at the graduate level (6000 level or higher) unless approved by the Director of Graduate Studies.
     - Enrollment in a dissertation course (ECE8399) is required during the semester the dissertation proposal is defended.

2. Coursework for the M.S. to Ph.D. Degree Plan
   - All supported students must enroll in the ECE department's seminar course (ECE 6011, or 6111)
every semester for the duration of their program.
- All structured coursework must follow the *Appropriate Coursework Standards*.
- At least 54 semester hours of graduate credit, of which at least 15 hours should be in structured
course work and at least 27 hours in research (ECE8x98) and 12 hours of dissertation
(ECE8399). Additionally,
  - All of the 15 hours in structured coursework must be at the 6000 level or higher.
  - At least 9 of the 15 hours in structured coursework must be in ECE courses.
  - Non-ECE courses used to satisfy the structured course requirement must be related to
the field of study and be approved by the student’s advisor.
  - Non-ECE courses must be at the graduate level (6000 level or higher) unless approved
by the Director of Graduate Studies.
  - No credit will be given for any course that is equivalent to a course taken in the student’s
undergraduate degree program.
  - Enrollment in a dissertation course (ECE8399) is required during the semester the
dissertation proposal is defended.
- Fulfillment of the *Breadth Coursework* requirement.
- Completion of the *Qualifying Exam*.
- Preparation of a written dissertation and an oral defense thereof.
- Completion of all work above in accordance with the procedures described in the *Procedures, Requirements, and Standards Section*.

### Master of Science (MSEE, with Thesis) Program

1. To receive the degree of Master of Science in Electrical Engineering, a student is required to complete,
on a part-time or full-time basis, a minimum of 30 semester credit hours of graduate studies, to include at
least 18 hours of coursework, and 12 hours of thesis and research. Specifically,
   - At least 15 hours of structured coursework in ECE, at or higher than the 6000 level. Out of these,
     at least 6 hours should be in the area of specialization of the student.
   - Out of the minimum of 18 hours of coursework, 3 hours should be in a related technical field
     outside the area of specialization of the student. These courses should be graduate level,
deemed appropriate for the professional development of the student (i.e., courses related to the
thesis topic), and may be from a department outside ECE. Both the student’s thesis advisor and
the Director of Graduate Studies must approve them. In any case, no credit will be given for
courses that are equivalent to courses used in the student’s undergraduate degree.
   - Six hours of thesis (ECE 6399 and ECE 7399) and at least 6 hours of research (ECE 6x98).
2. Preparation of a written thesis and an oral defense thereof.
3. Completion of all work above in accordance with the procedures described in the *Procedures, Requirements, and Standards Section*.

### Master of Science in Electrical Engineering (MSEE, Non-thesis) Program

(“Students who began their current MSEE, Non-thesis graduate program prior to the Fall 2018 term may follow
the previous requirements for the MSEE, Non-thesis program.”)

To receive the degree, Master of Science in Electrical Engineering, non-thesis, a student must complete, on a
part-time or full-time basis, a minimum of 30 semester credit hours of approved graduate courses. There is no
thesis requirement. A maximum of two courses (i.e., a maximum of 6 hours of coursework) taken from Course Categories A (Core) and B (Electives) can be replaced by an approved project to be completed under the supervision of a faculty member from the Electrical and Computer Engineering Department. In all cases, no credit will be given for courses that are equivalent to courses used in the student's undergraduate degree.

Specifically:

**Specialization Areas:** Students must choose one of the ten specializations listed below and complete all required courses for that specialization to fulfill the requirements of the MSEE, Non-thesis program.

- **Specialization requirements:** Students must complete all ?Mandatory Core? courses specified for their chosen area of specialization. They must also take ?Specialized Elective? courses, chosen from among the elective courses that are designated for their area of specialization. A total of six courses (at least 18 credit hours) are required from within their area of specialization.
  - Any deviation from the approved specialization options will require approval from the Director of Graduate Studies.
  - A maximum of 6 hours of 6000-level courses equivalent to 5000-level courses is allowed in this category.
  - Other courses may be used in this category only with the prior approval of the Director of Graduate Studies.

**Elective and breadth requirements:** An additional six courses (12 credit hours) must be completed by taking general Elective and Breadth courses.

- **Electives.** Three to six hours* of course work offered in the College of Engineering or in the College of Business Administration.
  - All elective courses must be graduate level.
  - Business courses should be selected from the approved list (see below).
  - Other courses may only be used in this category with the prior approval of the Director of Graduate Studies.

- **Breadth.** Six to nine hours* of course work outside of your chosen specialization area in the College of Engineering or in the College of Natural Sciences and Mathematics (NSM).
  - All breadth courses must be graduate level.
  - Courses in ECE must be chosen from the list of approved Breadth Coursework.
  - NSM courses should be selected from the approved list (see below).
  - Other courses may only be used in this category with the prior approval of the Director of Graduate Studies.

*Elective and Breadth coursework must add up to 12 credit hours.

**Bio & Neuro Engineering**

*Faculty Coordinator: Dr. Jose Luis Contreras-Vidal*

- **Mandatory Core (9 credit hours):**
  - ECE 6302 - Introduction to Neuroengineering
  - ECE 6315 - Neural Computation
  - ECE 6337 - Introduction to Stochastic Processes
- **Specialization Electives (choose 3 courses/9 credit hours):**
  - ECE 6313 - Neural Networks
- ECE 6304 - Visual System: Physiology, Computation, and Methods
- ECE 6333 - Signal Detection and Estimation Theory
- ECE 6396 - Advanced Topics in Biomedical Engineering
- ECE 6397 - Introduction to Robotics
- ECE 6397 - Rehabilitation Engineering
- ECE 6397 - Brain-Machine Interfacing

An additional 12 credit hours of approved Elective and Breadth courses must be taken to equal a total of 30 semester credit hours.

**Communication and Networking**

*Faculty Coordinator: Dr. Zhu Han*

- **Mandatory Core (choose 3 courses/9 credit hours):**
  - ECE 6332 - Wireless Telecomm Systems
  - ECE 6321 - Principles of Internetworking
  - ECE 6323 - Optical Fiber Communications
  - ECE 6397 - Introduction to Cybersecurity
  - ECE 6333 - Detection and Estimation Theory
- **Specialization Electives (choose 3 courses/9 credit hours):**
  - ECE 6397 - Sparse Representations for Signal Processing
  - ECE 6376 - Pattern Recognition
  - ECE 6397 - Machine Learning
  - ECE 6342 - Digital Signal Processing
  - ECE 6364 - Digital Image Processing
  - ECE 6337 - Introduction to Stochastic Processes
  - ECE 6397 - Physiological Signal Processing
  - ECE 6354 - Digital Video
  - ECE 6382 - Engineering Analysis

An additional 12 credit hours of approved Elective and Breadth courses must be taken to equal a total of 30 semester credit hours.

**Computer Engineering**

*Faculty Coordinator: Dr. Yuhua Chen*

- **Mandatory Core (9 credit hours):**
  - ECE 6372 - Advanced Hardware Design
  - ECE 6373 - Advanced Computer Architecture
  - ECE 6310 - Introduction to Robotics
- **Specialization Electives (choose 3 courses/9 credit hours):**
  - **Computer Architecture**
    - ECE 6367 - Computer Architecture and Design
    - ECE 7373 - Advanced Topics in Computer Architecture
  - **Integrated Circuits**
An additional 12 credit hours of approved Elective and Breadth courses must be taken to equal a total of 30 semester credit hours.

Controls and Robotics

*Faculty Coordinator: Dr. Aaron Becker*

- **Mandatory Core (9 credit hours):**
  - ECE 6325 - State-Space Control Systems
  - ECE 6335 - Digital Control Systems
  - ECE 6310 - Introduction to Robotics

- **Specialization Electives (choose 3 courses/9 credit hours):**
  - **Advanced Controls**
    - ECE 6394 - Control System Component Design
    - ECE 6390 - Linear Multivariable Control Systems
    - ECE 7331 - Non-Linear & Time-Varying Feedback Systems
    - ECE 7332 - Design/Stat Control Sys
    - ECE 7333 - Optimal Control Systems
    - ECE 7334 - Advanced Digital Control Systems
    - ECE 7335 - Robust Control Systems
  - **Math Related**
    - ECE 6382 - Engineering Analysis
  - **Power Systems**
    - ECE 6380 - Power Electronics and Electric Drives
    - ECE 6378 - Power System Analysis
    - ECE 6397 - Smart Grid Technology
  - **Intelligent Systems**
    - ECE 6376 - Digital Pattern Recognition (requires ECE 6337)
    - ECE 6313 - Neural Networks
  - **Signal and Image Processing**
    - ECE 6342 - Digital Signal Processing
    - ECE 6337 - Stochastic Processes
    - ECE 6364 - Digital Image Processing (requires ECE 6342)
  - **Computer Engineering**
    - ECE 6336 - Advanced Microprocessor Systems
  - **Power and Energy Systems**
- PES 6320 - Transformers and Electric Machines (ECE 6319)
- PES 6314 - Adjustable speed Motor Drive systems (ECE 6317)
- PES 6310 - Power Electronics Converters and Control (ECE 6311)
- PES 6332 - Smart Grid Systems (ECE 6327)

An additional 12 credit hours of approved Elective and Breadth courses must be taken to equal a total of 30 semester credit hours.

Electromagnetics

**Faculty Coordinator: Dr. David Jackson**

- **Mandatory Core (9 credit hours):**
  - ECE 6340 - Intermediate Electromagnetics
  - ECE 6351 - Microwave Engineering
  - ECE 6352 - Antenna Engineering
- **Specialization Electives (choose 3 courses/9 credit hours):**
  - **Antennas**
    - ECE 6345 - Microstrip Antennas
  - **Computational EM**
    - ECE 6350 - Numerical Methods in Electromagnetics
  - **General EM**
    - ECE 6341 - Advanced Electromagnetic Waves
  - **Materials**
    - ECE 6312 - Fundamental of Ferromagnetic Materials & Devices
  - **Math Related**
    - ECE 6382 - Engineering Analysis I
  - **Optics**
    - ECE 6323 - Optical Fiber Communications
    - ECE 6358 - Optoelectronics and Photonics: Principles and Applications
  - **RF and Microwaves**
    - ECE 6353 - RF & Microwave Electronics
  - **Well Logging**
    - ECE 6355 - Introduction to Well-Logging Techniques
  - **Special Topics**
    - ECE 7397 - Advanced Topics in Electromagnetic Waves (needs approval by specialization coordinator)

An additional 12 credit hours of approved Elective and Breadth courses must be taken to equal a total of 30 semester credit hours.

Microelectronics Circuits and Systems

**Faculty Coordinator: Dr. Jinghong Chen**

- **Mandatory Core (10 credit hours):**
  - ECE 6346 - VLSI Design
ECE 6328 - CMOS Analog Integrated Circuits
ECE 6466 - Integrated Circuit Engineering

- Specialization Electives (choose 3 courses/9 credit hours):
  - ECE 6353 - RF and Microwave Electronics
  - ECE 7349 - Advanced Topics in Microelectronics
  - ECE 6370 - Advanced Digital Design
  - ECE 7366 - Advanced Process Integration for VLSI
  - ECE 6347 - Advanced Topics in MOS Devices
  - ECE 6342 - Digital Signal Processing
  - ECE 6351 - Microwave Engineering

An additional 12 credit hours of approved Elective and Breadth courses must be taken to equal a total of 31 semester credit hours.

Nanotechnology

Faculty Coordinator: Dr. Dmitri Litvinov

- Mandatory Core (9 credit hours):
  - ECE 6306 - Introduction to Nanotechnology
  - ECE 6307 - Nanomaterials and Solar Energy
  - ECE 6314 - Nanoscale Design & Fabrication

- Specialization Electives (choose 3 courses/9 credit hours):
  - ECE 6308 - Advanced Batteries: Principles, Materials, and Devices
  - ECE 6309 - Microlithography for Micro-and Nano-system Manufacturing
  - ECE 6312 - Fundamental of Ferromagnetic Materials & Devices
  - ECE 6339 - Biophotonics
  - ECE 6348 - Material Science of Thin Films
  - ECE 6349 - Applied Solid State Theory
  - ECE 6358 - Optoelectronics and Photonics: Principles and applications
  - ECE 6362 - Compound Semicond Technology
  - ECE 6384 - Micro-Nano-Electro-Mechanical Systems and Nano Devices
  - ECE 6397 - Advanced Imaging Techniques
  - ECE 7349 - Advanced Topics in Microelectronics

An additional 12 credit hours of approved Elective and Breadth courses must be taken to equal a total of 30 semester credit hours.

Optics and Photonics

Faculty Coordinator: Dr. Wei-Chuan Shih

- Mandatory Core (choose 2-3 courses/6-9 credit hours):
  - ECE 6302 - Introduction to Neuroengineering
  - ECE 6315 - Neural Computation
  - ECE 6337 - Introduction to Stochastic Processes

- Specialization Electives (choose 3-4 courses/9-12 credit hours):
- ECE 6307 - Nanomaterials and Solar Energy
- ECE 6314 - Nanoscale Design & Fabrication
- ECE 6309 - Microlithography for Micro-and Nano-system Manufacturing
- ECE 6349 - Applied Solid State Theory
- ECE 6362 - Compound Semiconductor Technology
- ECE 6384 - Micro-Nano-Electro-Mechanical Systems and Nano Devices
- ECE 6397 - Advanced Imaging Techniques
- ECE 6342 - Digital Signal Processing
- ECE 6337 - Stochastic Processes
- ECE 6364 - Digital Image Processing (requires ECE 6342)
- ECE 6340 - Intermediate EM Waves

An additional 12 credit hours of approved Elective and Breadth courses must be taken to equal a total of 30 semester credit hours.

**Signal and Image Processing**

*Faculty Coordinator: Dr. Saurabh Prasad*

- **Mandatory Core (9 credit hours):**
  - ECE 6342 - Digital Signal Processing
  - ECE 6364 - Digital Image Processing
  - ECE 6337 - Introduction to Stochastic Processes
- **Specialization Electives (choose 3 courses/9 credit hours):**
  - **Foundations of Signal and Image Processing**
    - ECE 6397 - Sparse Representations for Signal Processing
    - ECE 6333 - Detection and Estimation Theory
    - ECE 6376 - Pattern Recognition
    - ECE 6397 - GPU Programming
    - ECE 6397 - Machine Learning
  - **Applications**
    - ECE 6332 - Wireless Telecomm Systems
    - ECE 6397 - Physiological Signal Processing
    - ECE 6354 - Digital Video
  - **Math Related**
    - ECE 6382 - Engineering Analysis

An additional 12 credit hours of approved Elective and Breadth courses must be taken to equal a total of 30 semester credit hours.

**Power and Energy Systems**

*Faculty Coordinator: Dr. Kaushik Rajashekara*

- **Mandatory Core (9 credit hours):**
  - ECE 6305 - Power Electronics Converters and Control
  - ECE 6326 - Power System Analysis
Specialization Electives (choose 3 courses/9 credit hours):
- ECE 6319 - Transformers and Electric Machines
- ECE 6317 - Adjustable speed Motor Drive systems
- ECE 6327 - Smart Grid Systems
- ECE 6329 - Power System Protection, Monitoring and Control
- ECE 6334 - High Voltage Electrical Substations Design and Architecture
- ECE 6318 - Advanced Power Converters and Applications

An additional 12 credit hours of approved Elective and Breadth courses must be taken to equal a total of 30 semester credit hours.

Approved List of Non-ECE Courses

- College of Engineering
  - All courses at the 6000 level or higher unless approved by the Director of Graduate Studies.

- College of Natural Sciences and Mathematics
  - All Graduate level courses, with the exception of the following:
    - COSC 6301, 6302, 6303, 6304, 6305, 6306, 6308, 6309, 6310
    - GEOL 6321, 6322
    - MATH 5310
    - PHYS 5311, 5312, 5397

- College of Business Administration:
  - All graduate level courses, with the exception of any courses in General Business Administration (GENB).
  - Reminder: course(s) that do not receive a letter grade, but are graded S, U, or W will not be counted towards the degree plan.

Master of Science in Computer & Systems Engineering (MSCSE) Program

To receive the degree of Master of Science, the student is required to complete (on a part-time or full-time basis), with a grade point average of at least 3.0, a minimum of 30 semester credit hours for the non-thesis option or a minimum of 30 semester hours for the thesis option. Upon admission to the program, the student will meet with the Director of the CSE Program to develop a plan that involves any required prerequisite courses as well as the appropriate courses for the degree plan. If the student follows the thesis option he/she will be advised to find an advisor who will supervise and direct his/her research. The thesis advisor will subsequently advise the student about his/her degree plan.

1. Non-thesis Option:

- A student that follows the non-thesis option should complete a minimum of 30 semester credit hours of coursework (10 courses).
- Four of these courses should be from the List of Required ECE Courses while the remaining can be from the List of Suggested Elective ECE courses.
- A minimum of six courses should be from the Department of Electrical & Computer Engineering.
- A maximum of four courses can be from outside the ECE department. These courses must be from the
Department of Computer Science, College of Engineering, or College of Business Administration. No courses from the College of Technology can be used on the Degree Plan.

Before graduation the student's degree plan will have to be approved by the ECE Academic Advisor and the Director of the Computer and Systems Engineering Program.

2. Thesis Option:

- A student who follows the thesis option should complete a minimum of 30 semester hours (10 courses).
- A minimum of 21 semester credit hours of coursework (7 courses)
- Four of these courses should be from the List of Required ECE Courses
- Six hours of thesis (ECE 6399 and ECE 7399) and
- Three hours of research (ECE 6398)

Before graduation the student's degree plan will have to be approved by the thesis advisor, the ECE Academic Advisor, and the Director of the Computer and Systems Engineering Program.

List of Required ECE Courses

Choose 4 courses from the following required course list:

ECE 6370 Advanced Digital Design
ECE 6346 VLSI Design
ECE 6373 Advanced Computer Architecture
ECE 7373 Advanced Topics in Computer Architecture
ECE 6371 Fundamental Hardware Design
ECE 6372 Advanced Hardware Design
ECE 6328 CMOS Analog Integrate Circuits
ECE 6321 Principles of Internetworking

To satisfy the coursework requirements and form a meaningful coherent program of study, a student may choose the remaining ECE courses from the following list of Approved ECE Elective Courses.

List of Approved ECE Elective Courses

ECE 6313 Neural Networks
ECE 6315 Neural Computation
ECE 6316 Computational and Biological Vision
ECE 6321 Principles of Internetworking
ECE 6322 Introduction to Spread Spectrum Communications
ECE 6323 Optical Fiber Communications
ECE 6324 Digital Telephony
ECE 6328 CMOS analog ICs
ECE 6325 State Space Control systems
ECE 6330 Mobile Radio Communication Systems
ECE 6331 Advanced Telecommunications Engineering
ECE 6332 Wireless Telecommunication Systems
ECE 6335 Digital Control Systems
ECE 6336 Advanced Microprocessor Systems
ECE 6337 Introduction to Stochastic Processes and Random Variables
ECE 6342 Digital Signal Processing
ECE 6347 Advanced Topics in MOS Devices
ECE 6353 RF and Microwave Electronics
ECE 6354 Digital Video in Telecommunications
ECE 6356 Electronic Circuit design
ECE 6364 Digital Image Processing
ECE 6372 Advanced Hardware Design
ECE 6376 Digital Pattern Recognition
ECE 6390 Linear Multivariable Control Systems
ECE 6397 Robotics in Healthcare
ECE 6397 Introduction to Cybersecurity
ECE 6466 Integrated Circuit Engineering
ECE 7342 Advanced Topics in Signal Processing
ECE 7349 Advanced Topics in Microelectronics
ECE 7366 Advanced Process Integration for VLSI

*The above list is subject to change, and other graduate ECE courses can be taken with the approval of the Director of the CSE Program.

*In all cases no credit will be given for courses that are equivalent to courses used in the student’s undergraduate degree.

Restrictions for Courses Outside the ECE Department:

- All CS courses should be at the graduate level.
- COSC 6301, 6302, 6303, 6304, 6305, 6306, 6308, 6309, and 6310 cannot be used on the degree plan.
- All courses from the College of Business Administration should be at the 6000 level or higher.
- Courses from the General Business Administration (GENB) cannot be used on the degree plan.
- All the courses of the College of Engineering should be at the 6000 level or higher.
- Courses that do not receive a letter grade but are graded S, U or W will not be counted towards the degree plan.
- Non-ECE courses with similar content as ECE courses: In case a graduate level (6000 or above) course is offered in another department with similar content to a regularly offered ECE graduate course; graduate ECE students must take the ECE version. If the course in question is not offered regularly, or in the graduating semester, then the students may be allowed to take the non-ECE version by submitting a general petition. Under no circumstances will graduate credit be awarded for both the ECE and the non-ECE on of the course.

**IMPORTANT NOTE
Students must refer to ECE department policies and procedures for any information not covered in this document, including those found at http://www.ee.uh.edu/graduate/procedures-requirements-standards.