PhD Engineering - Emphasis in Electrical and Computer Engineering

Program of Study

This program of study is effective Spring Semester 2019 – Summer Semester 2021.

The ECE Emphasis further defines and focuses the student's Program of Study for the Ph.D. in Engineeringthrough the requirements below:

If entering with BS degree, a minimum of 73 hours beyond the bachelors is required as follows:

- ENGR 6910 Foundations for Engineering Research (3 credit hours).
- 2 semesters of ENGR 8950 Graduate Seminar (2 credit hours).*
- 12 credit hours of ECE Area of Emphasis coursework at the 8000 level (see list below).
- 21 additional credit hours must be taken exclusive of research and dissertation credit. At least 9 hours must be at the 8000 level. The remainder must be at the 6000 level or higher.
- A minimum of 35 credit hours of doctoral research and dissertation.
    - A minimum of 32 credit hours of research (ENGR 9000 or 9010). A typical student's research hours will exceed this minimum.
    - 3 hours of ENGR 9300 Doctoral Dissertation must be listed on the program of study.

If entering with MS degree, a minimum of 43 hours beyond the masters is required as follows:

- 2 semesters of ENGR 8950 Graduate Seminar (2 credit hours).*
- 9 credit hours of ECE Area of Emphasis at the 8000 level (see list below) .
- 6 additional credit hours of coursework at the 8000 level.
- A minimum of 26 hours of doctoral research and dissertation:
    - A minimum of 23 hours of research (9000 or 9010). A typical student's research hours will exceed this minimum.
    - 3 hours of 9300 Doctoral Dissertation must be listed on the program of study.

** Only 3 hours of Graduate Seminar may apply on the Ph.D. Program of Study. Students are strongly encouraged to continue regular attendance of speaker series presentations even if not formally registered in the seminar.*

Emphasis Area Courses

Coursework fulfilling the ECE Emphasis Area credit hour requirement for the Ph.D in Engineering or M.S. in Engineering degree may be chosen from one or more of the areas below. Courses will be reviewed each academic year and updated as needed to reflect new areas in the field.

Track 1: Control Systems

Through this track, students can gain expertise in the analysis and design of controllers for complex, large scale systems. The need for improved safety and a cleaner environment have posed countless challenges that can only be addressed through the design and implementation of intelligent feedback

controls. Numerous emerging applications for controls include cyber-physical systems (e.g., smart grids and intelligent transportation systems) and biological networks.

- ENGR 8240 - Instrumentation programming
- CSCI(ENGR) 8940 - Computational intelligence
- ENGR 8990 - Optimization Theory and Applications
- ENGR 8220- Nonlinear Control Systems

Track 2: Electronics & Photonics

Students develop an understanding of the design and analysis of systems involving electromagnetic waves from RF electronics to photonic systems for signal processing and communication and optical systems for image capture and processing. High-speed communication and signal processing at gigabit speeds requires sophisticated electro-optic systems that must be understood at both the device and the systems level. Modern optical imaging systems use a wide variety of electrical and photonic technologies to achieve everything from imaging biological systems at the nanometer scale to imaging distant galaxies.

- ELEE 8510 - Microwave Photonics
- ENGR 8570 - Topics in Advanced Microscopy
- ELEE 8530 - Advanced Optics and Photonics
- PHYS 8201 - Advanced Electromagnetic Theory I
- PHYS 8202 - Advanced Electromagnetic Theory II
- ENGR 8310 - MEMS Design
- ENGG 8840 - Advanced Image Analysis

Track 3: Cyber-physical Systems

This track develops in students an understanding of engineered systems that are built from, and depend upon, the seamless integration of computational algorithms and physical components. Advances in CPS will enable capability, adaptability, scalability, resiliency, safety, security, and usability that will far exceed the simple embedded systems of today. CPS technology will transform the way people interact with engineered systems -- just as the Internet has transformed the way people interact with information. New smart CPS will drive innovation and competition in sectors such as agriculture, energy, transportation, building design and automation, healthcare, and manufacturing.

- CSEE 8300 - Principles of Cyber-Physical Systems
- CSEE 8830 - AR/VR 3D User Interface Design
- ELEE 8240 - Instrumentation programming
- CSCI(ENGR) 8940 - Computational intelligence
- CSCI 8820 - Computer Vision and Pattern Recognition
- CSCI 8380 - Advanced Topics in Information Systems
- CSCI 8250 - Advanced Network Security Systems
- ENGG 8840 - Advanced Image Analysis
- ENGR 8990 - Optimization Theory and Applications

(continued)

Selected Course Offerings

Students may want to consider the following courses in building their Programs of Study, as appropriate:

- ENGR 4210/6210 Linear Systems
- ENGR 4220/6220 Feedback Control Systems
- ENGR 4230/6230 Sensors and Transducers
- ENGR 4240 Introduction to Microcontrollers
- ENGR 4250/6250 Advanced Microcontrollers
- ENGR 4260/6260 Introduction to Nanoelectronics
- ELEE 4040 Communication Electromagnetics
- ENGR 4620/6620 Biomedical Imaging

In addition, graduate courses from other colleges that are relevant for ECE students include:

- PHYS 8101 Quantum Mechanics I
- PHYS 8102 Quantum Mechanics II
- PHYS 8201 Advanced Electromagnetic Theory I
- PHYS 8202 Advanced Electromagnetic Theory II
- CSCI 8820 Computer Vision and Pattern Recognition
- CSCI 8380 Advanced Topics in Information Systems
- CSCI 8250 Advanced Network Security Systems