DOCTOR OF PHILOSOPHY IN ELECTRICAL AND COMPUTER ENGINEERING

Student Learning Outcomes

Students graduating from this program will:

- Demonstrate a thorough degree of knowledge in the discipline
- Demonstrate an ability to use proper investigation techniques for the discipline
- Use oral and written forms of communication to convey their ideas

Program Structure

Total Credits Required for Graduation: 42

Residence requirements: Ph.D. students must satisfy the doctoral residency requirement by satisfactory completion of at least 18 credits in no more than 24 consecutive months. When satisfying the residency requirement, all Ph.D. students are subject to the following restrictions:

- The doctoral residency requirement must be satisfied no later than the end of the semester in which the student completes his or her comprehensive examinations.
- Students must achieve a cumulative graduate grade-point average of at least 3.0 in all courses counted toward satisfying the residency requirement.

Electrical and Computer Engineering Topics:

- Computer Engineering, VLSI, and Embedded Systems Design
- Hardware Security, Cyber-Physical Systems, and Engineering
- Materials, Devices, and Sensors at the Nanoscale
- Electromagnetics, Radio Frequency (RF) circuits, Microwave, Terahertz (THz) Science and Engineering
- Communication and Signal Processing
- Computer Vision, Multimedia, and Artificial Intelligence (AI)
- Power Systems and Renewable Engineering
- Robotics and Control
- Electric Vehicles (EV) and Batteries

Admission Requirements

A student who meets the minimum discipline requirements stated below will be considered for regular admission to the Ph.D. program. A student who does not meet some of the requirements but shows high potential for advanced-level work, may be considered for provisional admission. Admission also depends on factors such as number of seats available, resources available in the area of student's interest, the quality of previous work, etc. A student who does not qualifying for admission to the Ph.D. program, may be considered for admission to the M.S. in Electrical Engineering program.

Minimum Recommended Ph.D. Admission Requirements:

1. GPA (Bachelor or equivalent Degree): 3.5 in the scale of 4 (or equivalent)
2. GPA (MS or equivalent Degree if any): 3.5 in the scale of 4 (or equivalent)
3. GRE (Quantitative) minimum score = 85%
4. TOEFL iBTS minimum Score = 89 or IELTS minimum score = 6.5
5. Prior Projects or Publications (Preferred)*
6. Internationally Acceptable Accreditation of the Prior Degree Awarding Institutes

*Prior research project and/or publication record is not required for admission into ECE Ph.D. program. However, doctoral faculty members give very high value to the students with such backgrounds.

Direct or Expedited Ph.D. Program

It is not required to have an MS or equivalent degree to apply to ECE Ph.D. program. We accept well-qualified and motivated students with a Bachelor's degree directly into our Ph.D. program. We actively encourage students in the Direct Ph.D. Program to try to complete the doctoral study within 4 or 5 years after the Bachelor degree. To complete the Ph.D. degree in an 19 expedited timeline, first, the student has to be dedicated and well qualified. Second, the student must make a comprehensive plan at the beginning of the doctoral study to complete all the relevant steps within a strict timeline, which is challenging but not impossible.

Clarification of Minimum Requirements and Decision Process

Academic Preparation
The applicant must have a bachelor and/or a master's degree in electrical and/or computer engineering, electronics, communications engineering or any other field requiring substantial training in at least one of the above fields and in mathematics with a GPA of 3.5 or better, cumulative as well as in the major field; and a GPA of 3.5 or better in all post-baccalaureate or post-master's degree work.

Aptitude for Advanced Work
The student must demonstrate an aptitude for advanced-level work through national/international standardized examinations such as the GRE. The expected performance level is the 85th percentile in the quantitative portion of the GRE examination.

- In rare occasion, ECE Ph.D. Discipline Coordinator exempts GRE requirement for students with outstanding publication or scholarly records in internationally renowned journals, conferences or similar forums.

Proficiency in English
The student must demonstrate his or her proficiency in oral and written communication in English through national/international standardized English examinations such as TOEFL, verbal portion of the GRE, etc. Because of this test, the student may be required to improve his or her oral and written communication in English before enrollment in the courses of the chosen disciplines.

- For students with a North American (USA and Canada) B.S. or M.S. degree the English Proficiency requirement is exempt.

Recommendation Letters
The student must provide at least three recommendation letters from professors from his or her previous institution(s). If the applicant has been out of school for several years, recommendation letters from his or her supervisors (technical) will be acceptable. However, even in this situation, a recommendation letter from his or her last academic institution is highly recommended. A recommendation from a faculty member in the Computer Science Electrical Engineering (CSEE)
Department at UMKC must be provided if the student has taken courses from or worked with the
CSEE faculty.

Statement of Goals and Objectives
The applicant must provide a 250 to 500 words essay on his/her goals and objectives of pursuing the Ph.D. in the chosen fields.

Program Requirements

The PhD in Electrical and Computer Engineering offers a rigorous curriculum designed to provide students with advanced knowledge and skills in a wide range of ECE topics. Students must complete 30 credits of coursework plus 12 dissertation research credits. Students can select their 30 credits of coursework from ECE topics. Non-ECE courses can also be selected after discussion and approval by the student's Primary Adviser.

Code	Title	Credits
Electrical and Computer Engineering Coursework:		**30**
Computer Engineering, VLSI, and Embedded Systems Design Coursework:		
E&C-ENGR 5528	Advanced Embedded Systems	
E&C-ENGR 5535	Hdl-Based Digital Systems Design	
E&C-ENGR 5542	Introduction to VLSI Design	
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Advanced Computer Architecture)	
E&C-ENGR 5533	Introduction to Analog and Mixed Signal Integrated Circuit Design	
E&C-ENGR 5534	Computer Arithmetic	
E&C-ENGR 5537	Mixed-Signal Integrated Circuit Design	
E&C-ENGR 5642	Advanced VLSI Design	
Hardware Security, Cyber-Physical Systems and Engineering Coursework:		
E&C-ENGR 5528	Advanced Embedded Systems	
E&C-ENGR 5535	Hdl-Based Digital Systems Design	
E&C-ENGR 5542	Introduction to VLSI Design	
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Advanced Computer Architecture)	
E&C-ENGR 5534	Computer Arithmetic	
E&C-ENGR 5642	Advanced VLSI Design	
CSEE 5110	Network Architecture I	
E&C-ENGR 5577	Wireless Communications	
E&C-ENGR 5580	Digital Signal Processing	
E&C-ENGR 5570	Principles of Digital Communication Systems	
CSEE 5111	Network Architecture II	
CSEE 5113	Network Routing	

Materials, Devices, and Sensors at the Nanoscale Coursework:	
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Nanoscale Devices & Circuits)
E&C-ENGR 5535	Hdl-Based Digital Systems Design
E&C-ENGR 5647	Emerging Interdisciplinary Research in Nanotechnology
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Nanoelectromagnetics and Plasmonics)
PHYSICS 5530	Quantum Mechanics I
PHYSICS 5531	Quantum Mechanics II
PHYSICS 5535	Optical Properties Of Matter
Electromagnetics, Radio Frequency (RF) circuits, Microwave, Terahertz (THz) Science and Engineering Coursework:	
E&C-ENGR 5513	Principles of Antenna Engineering
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Terahertz in 6G and beyond: from imaging to communications)
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Nanoelectromagnetics and Plasmonics)
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Numerical Methods in EM)
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Introduction to Microwave Engineering)
E&C-ENGR 5518	Advanced Radar Systems & Techniques
E&C-ENGR 5512	Microwave Remote Sensing
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (RF Experimental Design)
PHYSICS 5535	Optical Properties Of Matter
PHYSICS 5520	Electromagnetic Theory And Applications I
PHYSICS 5521	Electromagnetic Theory And Applications II
Communication and Signal Processing Coursework:	
CSEE 5110	Network Architecture I
E&C-ENGR 5577	Wireless Communications
E&C-ENGR 5580	Digital Signal Processing
E&C-ENGR 5570	Principles of Digital Communication Systems
CSEE 5111	Network Architecture II
CSEE 5113	Network Routing
COMP-SCI 5514	Optical Fiber Communications
COMP-SCI 5573	Information Security and Assurance
Computer Vision, Multimedia and Artificial Intelligence (AI) Coursework:	
E&C-ENGR 5578	Multimedia Communication
E&C-ENGR 5582	Computer Vision
E&C-ENGR 5316	Deep Learning (Please confirm course title - submitted in proposal as Neural & Adaptive Systems)
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Supervised Learning and Feature Extraction)
E&C-ENGR 5586	Pattern Recognition
E&C-ENGR 5584	Advanced Digital Image Processing
COMP-SCI 5530	Principles of Data Science
COMP-SCI 5540	Principles of Big Data Management
COMP-SCI 5542	Big Data Analytics and Applications
COMP-SCI 5561	Advanced Artificial Intelligence
COMP-SCI 5565	Introduction to Machine Learning
COMP-SCI 5565	Introduction to Machine Learning (Please confirm course title - submitted in proposal as Deep Learning????)
Power Systems and Renewable Engineering Coursework:	
E&C-ENGR 5536	Power Electronics II
E&C-ENGR 5567	Power Systems II
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Introduction to Smart Grid)
E&C-ENGR 5560	Electric Power Distribution Systems
E&C-ENGR 5557	Fundamentals of Solar Photovoltaic Cells
E&C-ENGR 5559	Introduction to Photovoltaic Systems
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Wind Energy)

E&C-ENGR 5563	Sustainable Energy System Engineering	
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Introduction to Power System Protection)	
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Power Quality)	
E&C-ENGR 5565	Auxiliary Electric System Design	
E&C-ENGR 5664	Lightning and Switching Surges in Power Systems	
E&C-ENGR 5672	Power Systems Relaying	
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Transmission System Planning)	
Robotics and Control Coursework:		
E&C-ENGR 5558	Automatic Control System Design	
E&C-ENGR 5556	Advanced Instrumentation and Control (IN PROCESS OF BEING DEACTIVATED)	
E&C-ENGR 5582	Computer Vision	
E&C-ENGR 5316	Deep Learning (Please confirm course title - submitted in proposal as Neural and Adaptive System)	
E&C-ENGR 5590	Special Topics In Electrical And Computer Engineering (Supervised Learning and Feature Extraction)	
E&C-ENGR 5584	Advanced Digital Image Processing	
MEC-ENGR 5559	Robotics and Unmanned Systems	
MEC-ENGR 5557	Mechatronics System Design	
Electric Vehicles and Batteries		
E&C-ENGR 5536	Power Electronics II	
MEC-ENGR 5559	Robotics and Unmanned Systems	
MEC-ENGR 5557	Mechatronics System Design	
E&C-ENGR 5699	Dissertation Research	12
Total Credits		**42**

Total Credit Hours: 42
Program Length: 4 years