

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 | Advanced Analog 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:

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| 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:

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|---------------|--|
| 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:

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| 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:

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| 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 Statistical Learning |
| COMP-SCI 5565 | Introduction to Statistical Learning (Please confirm course title - submitted in proposal as Deep Learning????) |

Power Systems and Renewable Engineering Coursework:

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| 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) |

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| 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 | |
| MEC-ENGR 460 | (Electromechanical Conversion - Must be reactivated) | |
| E&C-ENGR 5699 | Dissertation Research | 12 |
| Total Credits | | 42 |

Total Credit Hours: 42