The ECE Department’s PhD graduate research program is partitioned into three main areas of concentration and research:

**A. Signals and Communications** – including the following graduate level courses:

1) ECE 440 Introduction to Random Processes  
2) ECE 441 Detection & Estimation Theory  
3) ECE 442 Network Science Analytics  
4) ECE 444 Digital Communications  
5) ECE 445 Wireless Communications  
6) ECE 446 Digital Signal Processing  
7) ECE 447 Digital Image Processing  
8) ECE 448 Wireless Sensor Networks  
9) ECE 449 Machine Vision  
10) ECE 450 Information Theory  
11) ECE 451 (BME451) Biomedical Ultrasound  
12) ECE 452 (BME 453) Medical Imaging-Theory and Implementation  
13) ECE 453 Ultrasound Imaging  
14) ECE 457 Digital Video Processing  
15) ECE 471 Computational Models of Musical Processes  
16) ECE 472 Audio Signal Processing  
17) ECE 473 Computational Methods of Music  
18) ECE 475 Audio Software Design I  
19) ECE 476 Audio Software Design II  
20) ECE 477 Computer Audition  
21) ECE 479 Audio Recording – Technology and Fundamentals

**B. Integrated Electronics and Computer Engineering** – including the following graduate level courses:

1) ECE 400 Computer Organization  
2) ECE 401 Advanced Computer Architecture  
3) ECE 402 Memory Systems  
4) ECE 404 Microprocessor Architecture  
5) ECE 406 Introduction to Parallel Computing Using GPU's  
6) ECE 409 (CSC 446) Machine Learning  
7) ECE 429 Audio Electronics  
8) ECE 431 Computational Methods  
9) ECE 455 Software Analysis and Improvement  
10) ECE 461 Intro to VLSI  
11) ECE 462 Advanced CMOS VLSI Design  
12) ECE 463 VLSI Error Control Systems  
13) ECE 464 Fundamentals of VLSI Testing  
14) ECE 465/565 Performance Issues in VLSI/IC Design & Analysis  
15) ECE 466 RF and Microwave Integrated Circuits  
16) ECE 467 Advanced Analog Integrated Circuit Design  
17) ECE 468 Advanced Analog CMOS Integrated Circuit Design II  
18) ECE 469 High Speed Integrated Electronics
C. Physical Electronics, Electromagnetism, and Acoustics – including the following graduate level courses:

1) ECE 421 (OPT 421) Optical Properties of Materials
2) ECE 422 Nanoelectronic Devices
3) ECE 423 Semiconductor Devices
4) ECE 424 Intro to Cond Matter Physics
5) ECE 426 (OPT 468) Waveguides & Optoelectronic Devices
6) ECE 428 (OPT 425) Radiation and Detectors
7) ECE 432 Acoustic Waves
8) ECE 434 Microelectromechanical Systems
9) ECE 435 Introduction to Opto-Electronics
10) ECE 436 Nanophotonic and Nanomechanical Devices
11) ECE 438 Nonlinear Acoustics
12) ECE 474 (BME 474) Biomed Sensors, Circuits & Instrumentation
13) ECE 520 Spin-based electronics: theory, devices & applications

All first year PhD students must satisfy the following requirements for continuation in the PhD program:

1. **2+1+1 Course Requirement**: All PhD students must take and pass at least 2 graduate level courses (400-level) from their respective concentration area and at least one graduate level course from each of the two remaining areas. The courses must be taken during the first year of study. The specific courses are to be selected by the students in agreement with their research advisors.

2. **Area Exam**: All PhD students must take an oral exam before the end of their third semester of full-time study. The format of the oral exam (e.g., a question/answer session, a paper presentation or both) shall be determined by the Academic Advisor and shall be conducted in front of at least two faculty in the respective research area. The Advisor and/or Graduate Program Coordinator will provide general guidelines on what is expected of them for the exam. Upon completion of the oral exam, the exam committee shall provide the examination results to the Graduate Program Coordinator to be included in student’s academic record. The exam committee shall provide their recommendation at the conclusion of the oral exam, specifically if the student should be allowed to continue to the next stage of their graduate program, if remedial work is required and the exam re-taken, or if the student should not continue in the PhD program. Final action will be taken after the recommendation is approved by the Graduate Program Coordinator and the Department Chair.

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1 Students may petition to extend the time for completing these requirements. It is expected that part-time students and those with a non-ECE background may need additional time.