Revision to the Academic Requirements for First Year PhD Comprehensive Exam in ECE

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Effective Fall 2021

ECE Graduate Committee: M. Foster, M. Heilemann, S. Kose, Q. Lin, and G. Mateos (Chair)

The ECE Department's PhD graduate research program will be partitioned into five main areas of concentration and research:

1. ***Signals, Communication, and Imaging:*** Signal and Image Processing, Communications, Medical Imaging, Machine Learning
2. ***Integrated Electronics and Computer Engineering*****:** VLSI/IC Microelectronics, Computer Design/Architecture, Hardware Security, Machine Learning
3. ***Physical Electronics, Electromagnetism, and Quantum Engineering*****:** Superconductivity and Solid-State Electronics, Optoelectronics, Integrated Photonics, Microelectromechanics and Electrostatics
4. ***Audio and Acoustics*****:** Music Acoustics and Signal Processing, Acoustic Waves, Audio Electronics and Software Design
5. ***Robotics:*** Motion Planning, Navigation, Control, Estimation, Perception, Artificial Intelligence

From an evaluation perspective, the purpose of the First Year PhD Comprehensive Exam in ECE along with the graduate coursework requirements is twofold. The first goal is to assess the student's breadth of knowledge pertaining to the fundamental concepts in ECE. The second objective is to assess the student's potential to perform research while working in an area of concentration in ECE, as well as the student's ability to communicate their research (orally and in writing).

Starting Fall '21, all first year PhD students must satisfy the following (depth and breadth) requirements for continuation in the PhD program:

1. 4+2 Course Requirement: Upon joining the PhD program, a student should claim one of the above areas of concentration. A detailed list of courses falling under each area of concentration breadth of knowledge requirement. The specific courses are to be selected by the students in agreement with their research advisors.

Students with no prior ECE background at the undergraduate or MS level should take the new entry-level graduate course ECE 402 - Electrical Engineering Fundamentals in the Fall of their first year of study. This 4-credit course *will count as one of the two courses required outside their area of concentration*. By inspecting the students' transcripts, the Graduate Admissions Committee can indicate who should take this course. Students with an MSc in EE degree will be exempt from this leveling requirement.

Under specific circumstances requiring approval from the student's PhD advisor and the ECE Graduate Committee, relevant courses from other programs (e.g., Mathematics or Computer Science) could be considered to satisfy the 4+2 Course Requirement. Likewise, if a core course deemed to be important to the student's training is not offered during their first year of studies (some ECE graduate courses are offered every other year), the student could petition to take it during their second year.

UR MS EE students that transition to the PhD program will have already taken 6 of our courses and should be exempt from additional coursework requirements. Students coming from other UR MS degree programs, like Physics and Optics, may have taken some of these courses but would most likely need to take at least a few more. For these cases (or if an UR MS EE student decides to change their area of concentration), additional course requirements should be set on a case-by-case basis. Incoming PhD students with an MS degree from other schools should complete the 4+2 Course Requirement outlined above. In e. (y)4 (earon1 6a0dTcd8 5j1C (s1E)1Tw(-)3091 (E)1 4

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Each year, ~2 faculty per area of concentration will take on the responsibility to serve in the examination committees of all the students in that area (nominally, 2-4 students or even less). Maintaining a fixed committee to evaluate all exams in that particular year and area has the advantage of providing more consistent evaluation criteria across the student cohort. *The student's PhD advisor will be included in the committee*. This would allow the advisor to provide general recommendations to the student about the exam.

The proposed PhD Comprehensive Exam will consist of two intertwined parts: (i) submission of a written report; and (ii) an oral presentation to the exam committee followed by questioning.

Written Exam: The written exam requires the student to submit a report. The purpose of the written report is to assess a student's readiness and potential for PhD-caliber research. The report should demonstrate that the student has sufficient depth of knowledge in their intended area of concentration and research. The student's ability to understand and think critically about their research topic will be assessed, as well as their ability to communicate clearly and effectively in written English.

In terms of scope, the written report should be an in-depth review/study of a research paper/project assigned by the area exam committee. The choice of format (assigning papers to critique versus applied projects for the students to work on) is left to the discretion of the area exam committees. The same format should be adopted for all students in the concentration area any given year, and the final deliverable should always be a written report. The choice of the paper assigned can be informed by e.g., keywords defining subareas of interest submitted by the student or a recommendation made by the student's PhD advisor (for instance, so that the time spent working on the exam also contributes to the student's own research in their lab). In the submitted report, the student should provide a critical evaluation of the paper by means of thorough explanations of the key concepts and trade-offs, positioning in the context of related work (with adequate references) and provide insight into promising areas of future work (especially if the paper represents the state-of-the-art). The area exam committee members could provide additional specific information and guidelines of what is expected of the students when preparing the report.

As far as the format is concerned, the report should be submitted as a single PDF file not exceeding, say, 8 pages and using the format and style guidelines for submission to IEEE Transaction journals. This way, students will be nudged towards typing with LaTeX, while using a specific template they are likely to encounter down the road. The written material in the report

As far as the format is concerned, the oral component is conducted as a closed-door examination. The duration of the presentation should be ~30 minutes, followed by no more than 30 additional minutes of Q&A. The questions posed by the committee will be mostly about the contents of the written report and the ensuing presentation. Optionally, the committee can pose additional questions about ECE fundamentals within the area of concentration, including material from the first-year graduate courses taken by the student.

The oral examinations will be scheduled for the week of ~*July 1st*. This should give enough time for the students to work on their presentations after submitting their reports, and for the committee members to read and grade the written exams.

In making the final PhD Comprehensive Exam Pass/Fail recommendation, the committee members will vote based on the student's performance in both parts of the examination (perhaps also cons's perIn f1 1dIr presef10 (n)10 (.6 (i)6 (l)Tw 1.61 0 Td(-)T7.32.004 Tc -0.002 Tw 0.33 0 2d[(y)4 (ea