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Electrical & Computer ENGINEERING

ECE's New PhD Qualifying Exam: *All the Details*

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Background

- **In Jan 2001, ECE decided to restructure its PhD Qual Exam**
  - Based on numerous inputs from students and faculty
  - Based on growing concern that the exam no longer adequately tested for the critical skills that the ECE faculty believed to be essential for a PhD
- **In Spring 2001, a committee of faculty redesigned the Qual**
  - Interviewed all ECE faculty, and many ECE students, to gather ideas
  - Proposed not only a new Qual structure, but also changes in the requirements for other parts of the PhD degree
  - Presented to ECE faculty in April 2001, and ratified by faculty vote
  - New requirements start in **Fall semester 2001.**

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Overview

- **What do we want?** *Skills that matter for a PhD*
- **What courses to take?** *New PhD course requirements*
- **What's in the "Qual"?** *New PhD Qualifying Exam structure*
- **What about teaching?** *PhD teaching internship requirements*
- **What's left?** *Remaining steps to the ECE PhD*

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Overall Goals for the PhD Process

- **What skills *matter* for the PhD?**
  - In other words, what skills do we want you to be able to **demonstrate** to us?
- **Breadth**
  - No mandatory portfolio of areas; you demonstrate with graduate courses
- **Ability to think**
  - Logically, clearly, on-your-feet, under-some-pressure
- **Ability to speak**
  - From a prepared talk, and in response to live questioning
- **Ability to write**
  - Always been part of PhD proposal and defense; now part of the Qual, too
- **Ability to demonstrate steady progress**
  - We will monitor and offer feedback, as a dept., every Fall and Spring

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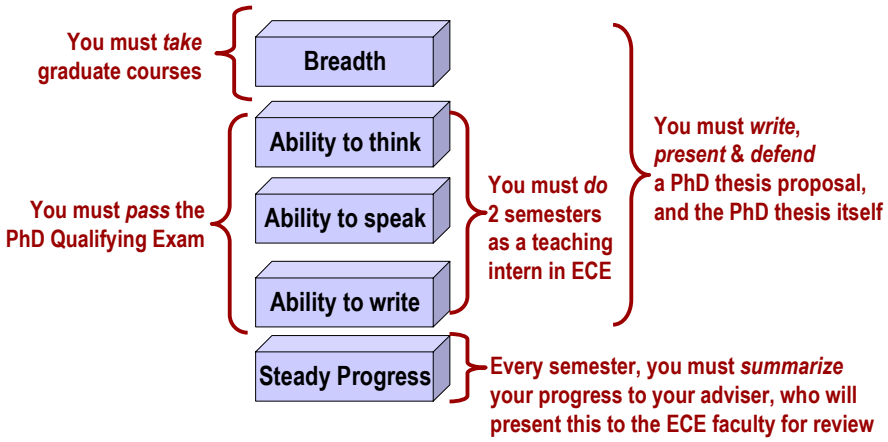
How Do You Demonstrate These Skills?

- ***Multiple* ways, all part(s) of the overall ECE PhD requirements**



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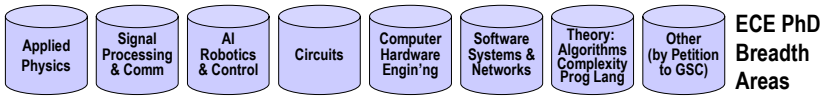
Breadth

- **About the PhD Breadth Requirement**
  - You demonstrate this with **courses** – in particular, graduate courses
- **Logistics**
  - ECE defines **8** technical areas as ***Breadth Areas***
  - You demonstrate breadth with graduate courses in these approved areas
  - Requirements depend upon your past degrees (next slides)



ECE PhD Breadth Areas

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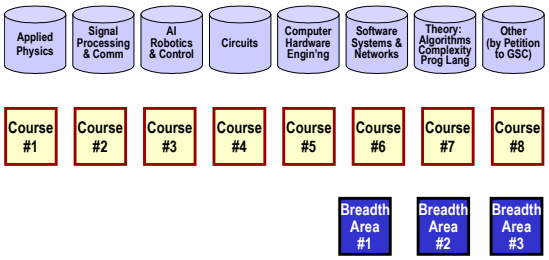
PhD Breadth Requirement



- **If you have a CMU ECE MS degree…**
  - You must take at least **8** classes from these breadth areas during **grad** studies
  - At least **6** of these courses must be graduate courses—at or above **700** level
  - At most **2** of these courses can be undergrad courses—below **700** level
  - You must complete at least **1** graduate course in **3** of these breadth areas
  - Courses taken at other schools **cannot** be used to satisfy these requirements
  - Courses taken for your ECE MS degree **can** count for **all** these requirements

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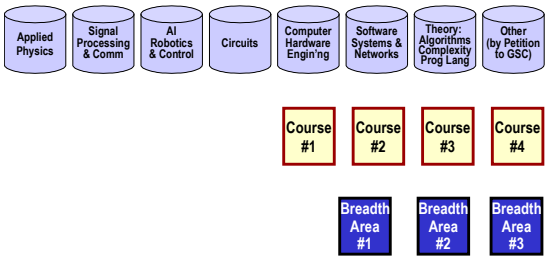
PhD Breadth Requirement



- **If you do not have a CMU ECE MS degree…**
  - You must take at least **4** classes from these breadth areas during **PhD** studies
  - At least **3** of these courses must be graduate courses—at or above **700** level
  - At most **1** of these courses can be undergrad courses—below **700** level
  - You must complete at least **1** graduate course in **3** of these breadth areas
  - You may petition for **1** grad course taken elsewhere to count for **1** Breadth Area
    - You still must take **4** courses--you only need grad classes in **2** breadth areas

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PhD Breadth: Common Questions

- ***Do you mean I need to take 8 more classes for my PhD?***
  - No. If you have a CMU MS in ECE, those classes count also
  - You must take 8 classes in total, during MS + PhD. Not 8 more for PhD.
  - For most students, this means 2-3 more classes after the MS
- ***Why are we allowed up to 2 undergrad classes?***
  - To help you get the background needed to take a graduate course in a 3rd ECE Breadth Area—if you don't already have that background
  - Use 3 of your 8 courses to get this Breadth Area covered: use 2 undergrad courses to get the basics, then do the graduate class after these 2
- ***I'm only "deep" in 1-2 ECE areas, can't I just use the undergrad classes to cover the 3rd ECE Breadth Area?***
  - No. You must ultimately do 1 **grad** class in each of 3 **different** areas.

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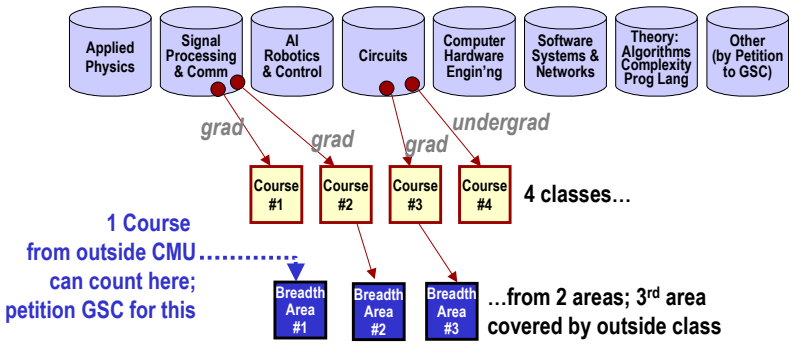
PhD Breadth: Common Questions

- ***I don't have a CMU MS degree, how many classes do I need?***
  - You need 4 classes: at least 3 graduate, at most 1 undergraduate
  - But, if you petition GSC to count 1 outside class to cover a Breadth Area, then you only need grad classes in 2 of these areas. See example below:



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PhD Breadth: Common Questions

- ***How do I "petition GSC"? What are rules for course transfer?***
  - GSC = ECE Graduate Studies Committee
  - Petition = you write a letter to GSC and describe the course you want to transfer to count for a breadth requirement
  - You must include
    - Name of the course, and name of the instructor, name of school
    - Official transcript that shows you took the class
    - Syllabus, description of class content, name of book, etc.
    - Brief description of the CMU graduate class that you believe this course is equivalent too, and why the courses are equivalent
    - GSC will only grant requests for courses that are **substantially identical** to the CMU graduate class you want to replace
  - And remember: you can only do this if you don't have a CMU MS, and you can only do this for one outside class, to count for one ECE Breadth Area

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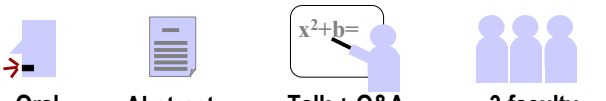
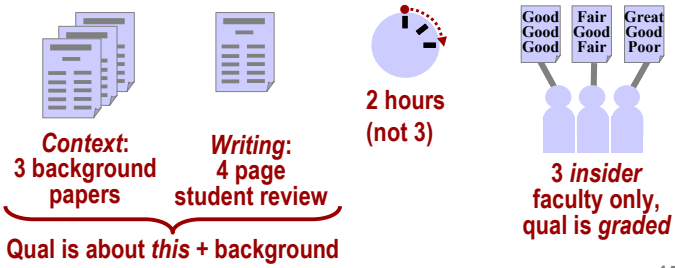
Thinking/Speaking/Writing: the Qual Exam

- **Executive summary**
  - Structurally similar to current qual – but much more focused
- **Logistics:**
  - Familiar parts:



  - New parts:



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Qual Exam Philosophy

- **After 1.5 years in PhD program, you should be able to:**
  - **Read** and **understand** 3 technical papers
  - **Review** these papers briefly, explain how they influence your work
  - **Talk** for 30 minutes about your own work (even if it's very early, preliminary)
  - **Answer** detailed questions about your work, about these ref papers, and the obvious undergraduate-level technical background for this material
- **What this exam is *not***
  - A depth exam for all work on the leading edge of this particular field
  - A breadth exam for anything the faculty feel "you ought to know"
- **What this exam is**
  - **Focused**: you get to claim that you know "**this stuff**". We test you on it.

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Exam Details: Three Background Papers

Context: 3 background papers

- **3 Papers provide context to faculty for your work**
  - What is your work about? Why does it matter?
  - Where did it come from? Why are you doing it like this?
- **Mechanics**
  - You select 3 papers (with advisor input)
  - GSC reviews paper choices, assigns 3-faculty committee
  - Broad latitude on "papers": conference, journal, book chapter, thesis chapter, your own papers, tech reports, …
- **What are you allowed to pick for the 3 papers?**
  - No more than **2** papers may have authors currently at CMU
  - Only **1** paper can have you—the student—as an author
  - Total length, counting all 3 papers, should not exceed **50 pages**

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Exam Details: Written Review Paper

Writing: 4 page student review

- **You write one short review paper for the qual, too**
  - You **explain** your own work, and the background work in the three papers
  - Let's faculty see why **you** think the ref papers are the right ones for us to read to understand your area, and your work
- **Mechanics**
  - Rules: Keep it short; keep it professional
  - Mandatory format: 4 page 2-column conference format. (ECE web page will provide approved word processing templates)
  - Clear goals:
    - Explain your own technical area
    - Explain your own work
    - Explain how these 3 papers are relevant, and why selected

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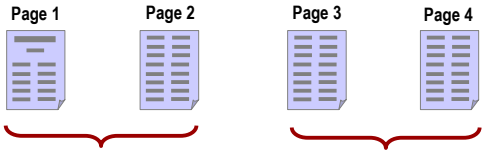
Exam Details: Written Review Paper

- **Suggested format**



Introduce the area.
Summarize the problem(s).
Explain the history.
Summarize key ideas & contributions of your 3 background papers.

Introduce your own work.
Summarize your own problem, goals.
Explain what prior ideas you use.
Summarize what you have done: key technical decisions, results.
Tell what worked, what didn't, why.

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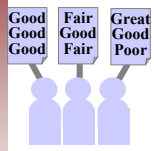
Exam Details: the Faculty Committee



3 *insider* faculty only, qual is *graded*

- **Committee reads 3 ref papers & review paper**
  - Exam is not about general breadth—it's all about **this** area, and **these** papers
  - 3 faculty chosen to understand (roughly) your area
- **Mechanics: Committee**
  - You submit an abstract (1page), 3 papers (3 copies of each), faculty sign-off sheet, list of up to 5 "most relevant" ECE faculty
  - GSC selects 3 person Qual committee as they see fit
- **Mechanics: Scoring**
  - Each faculty **scores**: your talk, your review paper, your Q&A
  - Result of qual is not (yet) pass/fail, it's **written eval** of your qual

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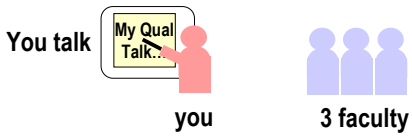
Exam Details: the Exam Itself

- **Oral, 2 hours**
  - **30 mins:** you talk first, about your work, from prepared slides
  - **90 mins:** questions from your 3 faculty members, about your area, the ref papers, your review paper, basic background



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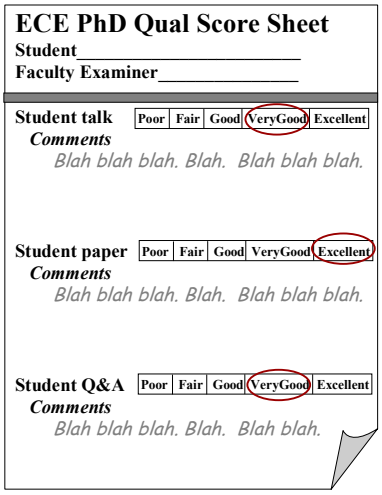
Exam Details: the Exam Itself

- **After the exam**
  - You get a **Score Sheet** from each of the 3 faculty examiners
  - This is quick feedback on your performance
  - You pick up a copy of the score sheets from the ECE Grad Office; available within 24 hours of exam.
  - But--this is **not** the Pass/Fail decision (yet)



ECE PhD Qual Score Sheet

Student_____

Faculty Examiner_____

Student talk Poor | Fair | Good | **VeryGood** | Excellent

Comments

Blah blah blah. Blah. Blah blah blah.

Student paper Poor | Fair | Good | VeryGood | **Excellent**

Comments

Blah blah blah. Blah. Blah blah blah.

Student Q&A Poor | Fair | Good | **VeryGood** | Excellent

Comments

Blah blah blah. Blah. Blah blah.

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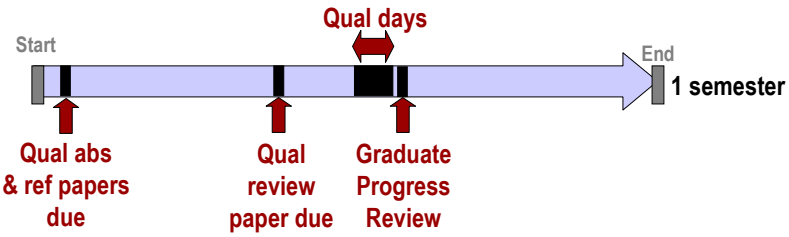
Changes to Qual Timing, Decision Process

- **Quals are not randomly scheduled over semester anymore**
  - They all happen in a confined time frame, scheduled at semester start



- **Qual outcomes not decided until all faculty look at all scores**
  - Normalizes, standardizes performance expectations
  - Allows student's overall performance record in ECE to be reviewed
  - Allows appropriate input from the thesis adviser, after the qual oral exam

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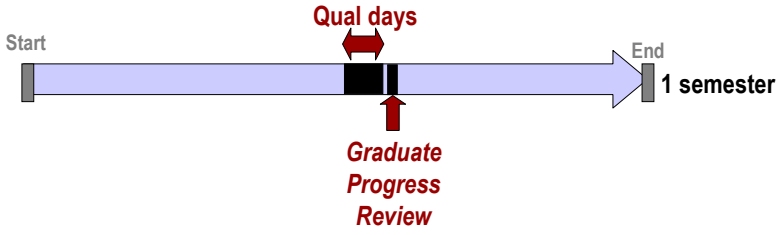
Graduate Progress Review

- **General faculty meeting, reviews *all* PhD students, each semester**
  - Not just qual-takers, but everybody in PhD program



- **What happens at the "GPR" meeting**
  - Faculty reviews all PhD Qual Exam results—decides Pass/Fail at this time
  - Faculty also reviews all other PhD students—provides brief feedback to each

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Graduate Progress Review

- **Mechanics**
  - Every Fall and Spring semester, each PhD student writes a paragraph of goals & accomplishments, emails this to thesis advisor
  - Adviser presents this to Progress Review meeting
  - Output is reply letter from ECE that reviews performance, suggests any additional work or requirements for following semester.
- **Motivation**
  - Provides all students with written feedback each semester about progress
  - Helps identify students with problems, and propose solutions early
  - Helps ECE faculty become more familiar with all the PhD students in ECE

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Qual Process: Step by Step

1. **Qual application**
   - At the start of the semester, you apply to take the qual. You include your talk's title and abstract, and copies of your 3 reference papers
   - You also supply names of 5 "closest" ECE faculty to your area
2. **Review paper due**
   - 4-6 weeks later, you handin your 4-page review paper to the Grad office
3. **ECE Qual committees announced**
   - Committees announced shortly before Qual Days, not at semester start
4. **Qual Days—oral exams for all qual takers**
   - You will be told when/where your 2 hour qual is scheduled
   - After the qual, you can get copies of your score sheets from Grad Office
5. **Grad Progress Review meeting**
   - Last day of "Qual Days", all ECE faculty meet, decide qual Pass/Fails

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Qual Exam: Common Questions

- ***So, what's really different about the new Qual exam?***
  1. It's no longer a "breadth" exam: it **only** covers the material in the area defined by your 3 reference papers, and your own research talk
  2. It's much more **focused**: the 3 reference papers provide the essential background context for the exam, and you get to pick them.
  3. It includes a **writing** requirement, which is new. Your paper will help the faculty committee understand how you think about this technical area
  4. The **timeline** is very different: all quals happen in a short span during the semester, and are no longer randomly scheduled.
  5. Faculty **committee** announced shortly before exam, not at semester start
  6. Oral exam itself has a **new format**: 2 hours, not 3 hours.
  7. Quals only given in **Fall & Spring** now; no more Summer Quals.
  8. **Scoring** is different: you get a Score Sheet with written feedback, then later you get a Pass/Fail, based on a review by the entire faculty.

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Qual Exam: Common Questions

- ***When do I need to take the Qual Exam?***
  - Within the **first 3 semesters** (not counting Summers) of your entry into the ECE PhD program
  - So, for example, if you start in Fall 200X, you have the Fall-200X, Spring-200X+1, and Fall-200X+1 semesters in which to complete the qual
- ***Do I need to complete any of the PhD breadth course requirements before I do the Qual Exam?***
  - No
  - However, we **strongly** advise you to complete **at least one** of the graduate breadth courses in your own technical area before doing the Qual
  - (Faculty ***always*** find it difficult to believe that students have "mastered" a technical area in which they have never finished an ECE grad course)

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Qual Exam: Common Questions

- ***How many chances do I get to pass the Qual?***
  - Two. If you fail twice, you have to leave the ECE PhD program
- ***If I fail once—what happens?***
  - You must take the Qual again the next time it is offered
  - You can use the same papers/talk, or change them.
  - You will get a different Qual committee, with one common member, from your first Qual committee
- ***Qual exam scoring is different from the Pass/Fail decision?***
  - Right. After the exam, you get a Score Sheet from each faculty, so you have some quick feedback about your performance
  - But, Pass/Fail is not decided until the Graduate Progress Review meeting, at which all Qual exam results are discussed and reviewed by the faculty

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Qual Exam: Common Questions

- ***What should I pick for reference papers?***
  - Consult with your **adviser** for ideas.
  - You want the papers to provide a good foundation and explanation for the work in your own talk
  - Consider a "basic" paper that is a tutorial or survey about the critical ideas in the area, then 2 papers that relate more specifically to your own work
  - Also, it is good to try for 1 of the papers to be fairly recent, so that faculty can see one example of recent work in the area
- ***Why the rules about papers with CMU authors, and my papers?***
  - We want to make sure you can read papers other than those written by you, or your adviser, or research colleagues inside CMU

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Qual Exam: Common Questions

- ***Can my adviser be on my own Qual Committee?***
  - No.
- ***If other CMU people are authors on my reference papers, can they be on my committee?***
  - Yes.
  - But, this does **not** guarantee that they will be on your committee. And, it does **not** guarantee that they won't be on your committee.
  - GSC decides on the staffing of the qual committees.
  - You do get to specify a list of "5 closest" ECE faculty to be on your committee, based on their technical areas. However, GSC does not guarantee that your committee will be drawn solely from this list.

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Qual Exam: Common Questions

- ***When will I know who is on my Qual Committee?***
  - Shortly before your Qual exam
  - Be aware that GSC reserves the right to make substitutions on your committee in order to be able to schedule all quals during Qual Days
  - However, GSC will always work to ensure you have a committee who can properly review and ask questions about your work
- ***How do I ask questions about what's on the Qual if I don't know who the committee is until just before the Qual?***
  - **Don't ask any qual questions to your committee before Quals.**
  - All ECE faculty dislike it when students ask "*what's going to be on the Qual?*"
  - You will be asked questions related to your talk, your paper, your references, and your general technical area. Prepare to answer such questions.

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Qual Exam: Common Questions

- ***I have not been working on original research for very long—how can I give a good Qual talk on incomplete work?***
  - We do not expect the Qual to be like a PhD thesis defense, with a large amount of mature, original work.
  - We do expect you to be able to **explain and justify** whatever you are working on—even if what are doing is mostly understanding the important prior work, and just implementing it or slightly extending it
- ***Will the Qual Committee have expert knowledge of all of my reference papers, and this technical area, and my own work?***
  - Maybe yes. Maybe no. They will be chosen to be **in your general area**
  - In the real world, audiences have a mix of experts and not-so-experts.
  - In the Qual, you should expect to be able to **explain and justify** your work to an expert, and to someone who is not so close to the work.

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Qual Exam: Common Questions

- ***"Explain & justify" means…?***
  - **Explain**: **what** are you doing? What technical decisions did you make? How is the work like previous work, or different from previous work?
  - **Justify**: **why** are you doing this? What technical goals do you have? There are alternative technical approaches for every problem—why are you attacking your problem in this particular way? What are the alternatives?
- ***How "deep" do I have to be about my 3 reference papers? They have 100s of their own refs—must I know them all?***
  - We expect you to understand the content of the 3 papers themselves…
  - …and enough of the background to be comfortable in the area.
  - Of course, there will be papers in the area you have not read, and ideas you do not know yet. We expect this.
  - Your goal is to be very **solid** on the 3 ref papers themselves, and on the **relationship** of your own research work to the ideas in these papers

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Qual Exam: Common Questions

- ***What questions beyond the specific topics of the 3 reference papers, and my own talk, might be asked in a Qual?***
  - Questions from **basic undergrad material directly relevant** to your area.
    - **Example**: if you are working on streaming digital media, it is OK for faculty to ask about Fourier Transforms, even if you don't use them.
    - **Example**: if you are working on streaming digital media, it is not OK for faculty to ask you to compute the current through an inductor
  - Questions about **assumptions and conventions** common to your area
    - **Example**: if you are working on low-power digital design, it is OK to ask what "power" is, how it gets computed for basic circuits, etc
    - **Example**: if you are working on operating system resource management, it is OK to ask what "response time" is, how to compute it

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Qual Exam: Common Questions

- ***My first language is not English. How much does this matter?***
  - Clear communication is very important. We understand if you are not as fluent or as quick in responding as a native English speaker.
  - Nevertheless, you must still be able to **respond** to probing oral questions, and you must still be able to **write** a well-structured review paper that meets the standards of English usage for a technical conference.
- ***How much help can I ask of my adviser for the talk & paper?***
  - It's OK to ask for **advice**—that's their job.
  - But, the talk, and the paper still need to be substantially the product of your own **individual** efforts.
  - It is **inappropriate** for your adviser to make your slides, or write your paper
  - Also ask your friends, and more senior PhD students, to **critique/review** here

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Qual Exam: Common Questions

- ***So, exactly what happens at the "Graduate Progress Review"?***
  - Qual exam results are **reviewed**, and Pass/Fail **decisions** made
  - Other PhD students' progress summaries are **presented** by their faculty adviser, and **discussed** by overall ECE faculty
  - A **response letter** is drafted, suggesting appropriate actions, goals, expected progress, etc., for the following semester, for each student.
  - Students with "more serious" problems of progress will get "more serious" letters with more **detailed expectations** of how they can get back on track
  - Students making **no** progress for a sufficient period will get an **"N-1"** letter; progress must be demonstrated over the following semester or the student will be asked to **leave ECE**
- ***Hey—isn't this just like "Black Friday" in Computer Science?***
  - Yes. But—we really **hate** that name.

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Implementation – When Does All This Start?

- **New quals start Fall 2001**
  - **All** students who need to take the PhD Qual will take the new Qual Exam from Fall 2001 onward.
  - **No** Quals will be given in the "old" format after Spring 2001
- **New PhD Breadth requirements**
  - Students admitted into the PhD program **before** Fall 2001 are **"grandfathered"** under the **old** PhD Breadth requirements.
  - All students admitted into the PhD **after** Spring 2001 must meet the **new** PhD Breadth requirements

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- What courses to take? *New PhD course requirements*
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- **What about teaching?** ***PhD teaching internship requirements***
- What's left? *Remaining steps to the ECE PhD*

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PhD Teaching Requirements

- **Teaching requirements**
  - Still 2 semesters – but **graded** for real
  - Need at least a "B" average over your 2 teaching assignments
  - Your performance matters here; you are not just "putting in time"

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- What's in the "Qual"? *New PhD Qualifying Exam structure*
- What about teaching? *PhD teaching internship requirements*
- **What's left?** ***Remaining steps to the ECE PhD***

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Remaining Steps to a PhD

- **PhD thesis proposal**
  - No changes here – you still need to write and present a satisfactory PhD thesis proposal
- **PhD thesis and defense**
  - No changes here – you still need to write and defend your PhD thesis

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Summary

- **What did we change?**
  - **Breadth:** more courses, less excuses
  - **Oral exam:** more focused, clearer goals, writing component, scored
  - **Timeline:** quals in one specified period in each semester, no summer quals
  - **Review:** at a general ECE faculty meeting, quals and all other PhD progress
- **Now what?**
  - New quals start Fall 2001
  - Still working on detailed scheduling for Qual Exams & Grad Progress Review
  - Expect more details about scheduling of Qual “steps” in Fall2001