



# **ECE PhD Qualifying Exam Overview**

***Diana Marculescu, Chair  
Graduate Studies Committee  
Department of Electrical and Computer Engineering  
Carnegie Mellon University  
Pittsburgh, PA***

***Revised Sept 2011***

# Thinking/Speaking/Writing: the Qual Exam

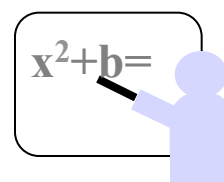
## ■ Logistics:



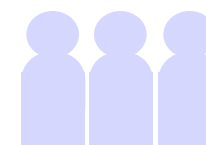
Oral



Abstract



Talk + Q&A



3 faculty



**Context:**  
3 background  
papers

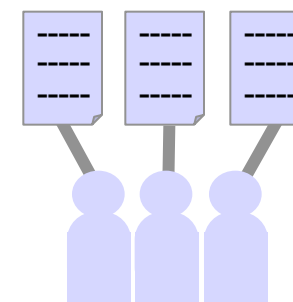


**Writing:**  
4 page  
student review

Qual is about *this* + background



**Scheduled  
for 3 hours**



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

# Qual Exam Philosophy

- After ~1.5-2.0 years in the Ph.D./M.S. 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 comprehensive exam for all work on the leading edge of this particular field
  - A open-ended exam for anything the faculty feel “you ought to know”
  
- **What this exam is**
  - **Focused**: you provide the technical scope for the exam. We test you on your understanding within that scope.
    - Exam based on material in your talk and the 3 papers and on the engineering underpinning of that material
  - Exam stresses your ability to understand and communicate technical linkages to the topics you have chosen.
    - This requires some breadth and some depth

# 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**

# Exam Details: Written Review Paper

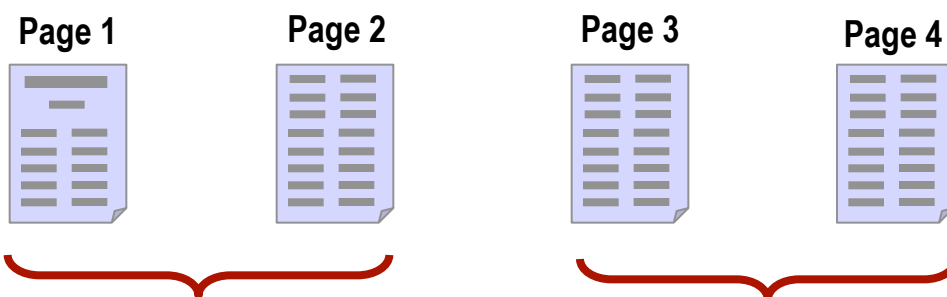


**Writing:  
4 page  
student review**

- **You write one short review paper for the qual, too**
  - You **explain** your own work, and the background work in the three papers
  - Lets 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; **make** it professional
  - Mandatory format: 4 page 2-column conference format. (ECE web page provides an approved word processing template)
  - Clear goals:
    - Explain your own technical area
    - Explain your own work
    - Explain relevance of these papers to your technical area

# Exam Details: Written Review Paper

- Suggested format



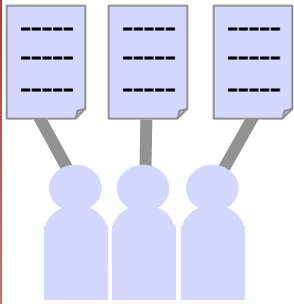
**Page 1**  
**Page 2**

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

**Page 3**  
**Page 4**

**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.**

# 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 (1 page), 3 papers (4 copies of each), faculty sign-off sheet, list of up to 7 “most relevant” ECE faculty
  - GSC selects 3 person Qual committee as they see fit
- **Mechanics: Evaluation**
  - Each faculty evaluates your paper, presentation and answers.
  - Result of qual is not (yet) pass/fail

# Evaluation Criteria on Grading Sheet

- **Demonstrates Oral Communications Skills**  
(e.g. comfortable having student present at a conference in an understandable way?)

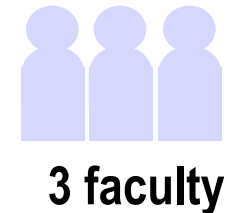
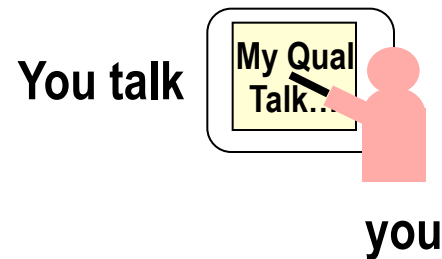
---
- **Demonstrates Written Communication Skills**  
(communicates problem, approach and results in writing?)

---
- **Demonstrates Ability to Interpret Results**  
(either their own or others)
- **Demonstrates Breadth of Knowledge**  
(understands the bigger picture and concepts *related to his/her work?*)
- **Demonstrates Depth of Knowledge**  
(has deep understanding of concepts and details *in his/her area?*)
- **Demonstrates Critical Thinking and Problem-Solving Skills**  
(applies principles and knowledge to probe deeper,  
understand trade-offs/fallacies/insights?  
finds solutions applying scientific or engineering skills?)

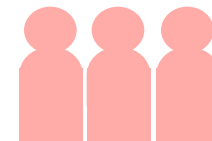
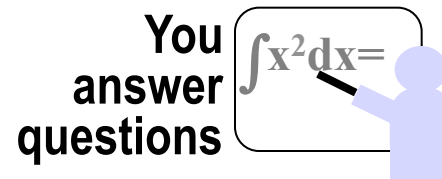
# Exam Details: the Exam Itself

- **Oral, 2 hours**  
(Scheduled for  
3 hours)

- **30 mins:** you talk first, about your work, from prepared slides

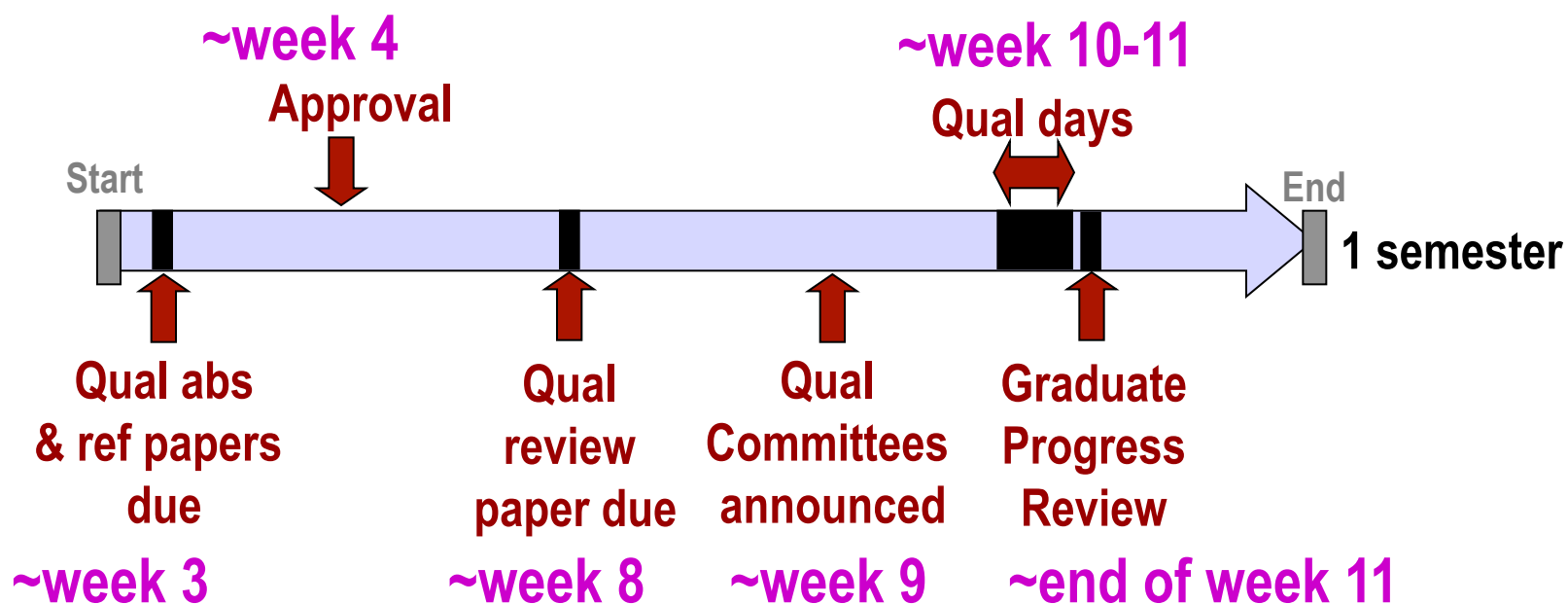


- **90 mins:** questions from your 3 faculty members, about your area, the ref papers, your review paper, basic background



# Qual Timing, Decision Process

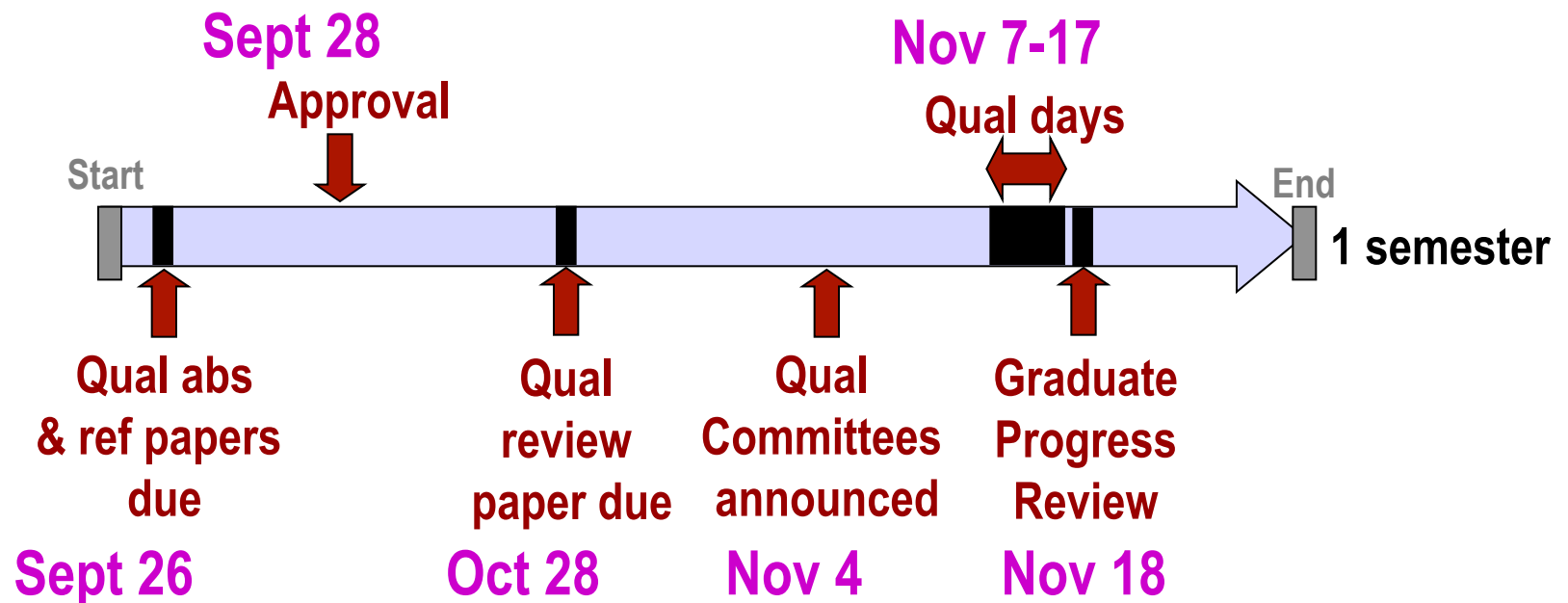
- **Qual outcomes not decided until **all** faculty meet**
  - Normalizes, standardizes performance expectations
  - Allows student's overall performance record in ECE to be reviewed
  - Allows appropriate input from the thesis adviser, after the qual oral exam



Exact dates are listed on the web for the current semester.  
The rough timing given here is indicative only.

# Qual Timing, Decision Process

- **Qual outcomes not decided until **all** faculty meet**
  - 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



Exact dates are listed on the web for the current semester.  
The rough timing given here is indicative only.

# Qual Exam: Common Questions

- ***When do I need to take the Qual Exam?***
  - First time by 5<sup>th</sup> semester
  - Two tries allowed
  - Must pass by the 6<sup>th</sup> semester.
- ***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)

# Qual Exam: Common Questions

- ***Can I take the Qual Exam if I am a Professional MS student?***
  - No.
  
- ***Is it a good idea to take the Qual Exam early?***
  - You must get your advisor's support to take the qual early if you are in the Ph.D./M.S. program but do not have your MS degree.
  - You should take it as soon as you are ready so that you can move on to the next phase of your Ph.D. research.
  - However, the clock for proposal starts once you pass the qual; you have 4 semesters to do your proposal.

# 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 Ph.D. 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 usually one common member from your first Qual committee
  
- ***Qual exam review is different from the Pass/Fail decision?***
  - Pass/Fail is not decided until the Graduate Progress Review meeting, at which all Qual exam results are discussed and reviewed by the faculty

# Qual Exam: Common Questions

- ***What should I pick for reference papers?***
  - Consult with your **advisor** 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

# Qual Exam: Common Questions

- ***Can my advisor 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 “7 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.

# 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?***
  - **You may not discuss the qualifier with your committee before Quals.**
  - You will be asked questions related to your talk, your paper, your references, and your general technical area. Prepare to answer such questions.

# 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
  
- ***Do I have to give the talk on my Ph.D. research?***
  - No.
  - Your work may be related to your Ph.D research, your prior M.S. research, or another research theme where you can demonstrate your depth and breadth to the committee.
  - Your Ph.D. or M.S. research is the most likely choice, however.

# Qual Exam: Common Questions

- ***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.
  
- ***“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?

# Qual Exam: Common Questions

- *How “deep” do I have to be about my 3 reference papers? They have 100’s of their own references—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 reference papers themselves, and on the **relationship** of your own research work to the ideas in these papers

# 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

# 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 advisor 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 **not allowed** for your advisor to make your slides, or write your paper
  - You may ask your friends, and more senior PhD students, to **critique/review**
  - You are **not allowed** to use text or figures directly taken from other papers (without quotation marks and a reference)

# Qual Instructions on the Web

- **Qualifying Examination Instructions and Procedures**  
<http://www.ece.cmu.edu/graduate/phd/qualifying.html>
- **The Declaration form that requires your advisor's signature can be downloaded from the web**  
<http://www.ece.cmu.edu/graduate/forms/>