Improving the Graduate Curriculum; Multi/Inter-Disciplinary Courses

Presenter: Randy Kamien
Moderator: Michael Thoennessen

Comment on these notes:
I attempted to organize these notes by topic rather than chronologically by comment. So, the ordering of many comments is different from the order in which they were stated.

Where possible I have attempted to indicate who made the remarks by their initials as follows:
RK = Randy Kamien
AP = Alexey Petrov
AZ = Andrew Zangwill
MT = Michael Thoennessen

Opening Remarks from the Presenter (RK):
[Showing descriptions of several graduate courses.]
The course content of the standard graduate courses is outdated. Shouldn’t we teach more modern and up-to-date topics?

- AP: I’m a particle theorist. For QFT, students need to have a certain basis before they can go on to other work.
- Several others agreed that we need to have a core that we teach first and build more modern applications on top of that.

Recommendation (RK):
We should make core courses that many people can take even if they are taken in departments other than physics. The students may learn different topics than tradition would dictate, but is that so bad? Can we teach the core things in a more compressed way instead of having so many different versions of the same material?

Comment:
The problem is more with how we are teaching these courses than the topical content. The kinds of problems that we assign are the issue.

- TR: Yes, when we teach these courses students don’t see the connection to modern applications. We need to show them the connections and not just assume they know. One of the problems is that there are too many theorists teaching the graduate courses. Experimentalists are more likely to make a connection to real world things.
- RK: Many Nobel Prize winners got where they are by talking to people with different backgrounds (physicists, chemists, engineers, etc.). We don’t encourage that multi-disciplinary approach in our students by the way we teach the core subjects. It’s easy to just teach the course we took. It takes a lot more effort to work in the modern stuff.
Comment:
This core stuff is what makes us physicists (knowing the vector calculus and so on). If we remove that, we are removing our essence.

Question:
To what extent are these topics (classical mechanics, E&M, quantum mechanics, and statistical mechanics) even the core? Several people noted that they no longer teach graduate classical mechanics.

- RK: What would happen in physics departments if we send students to, say the EE department, to take E&M? AZ: There would be an outcry. RK: Why? AZ: Because engineering courses tend to have a very narrow focus whereas physicists like to be more broad in scope. CK: There are very good engineering departments and very good courses in those departments. We physicists just tend to think that we can do it better.
- VM: An important question in all of this is “When does one become a physicist?” Is it after a bachelors, masters, or Ph.D.?

Question (MT):
Who has done something they feel is working?

- At Johns Hopkins we emphasize teaching them to become scientists rather than teaching them to know a list of topics. We reduced the number of courses and immediately pair students with faculty. We are more concerned with what they do in the lab than in courses.
- VM: By giving students research early, we are specializing them early. In that case, are we hurting their ability to do other things? We can think of a Ph.D. as a license to learn. We don’t have to teach them every topic. We teach them how to learn things themselves. Comment: In industry, we are much more interested in people who can pick apart a problem than we are in the details of the specific research they’ve done.
- At our school we don’t require QFT and we have different quantum mechanics tracks for different students. For some fields students only take one quantum mechanics course. RK: Then you are conceding that some students will never study certain basic things, which people have been saying is wrong.
- BP: In my Jackson E&M course, I’ve reduced the lectures from 3 to 2 and use one of the periods as a group problem-solving lab. They work in groups on problems that are conceptually challenging but analytically tractable. Then they do Jackson problems later. At the end they have to do a project, get to the key idea, form a simple model, teach this to the class, and produce a problem for the other students. You need to assign groups initially; otherwise they will self-segregate. We should give up the idea of telling students things and make them active participants in the learning. Make courses interactive, even at the graduate level – that’s how students learn.
- TR: At UCF we have added an extra hour (informally) for problem solving to which the faculty agreed – and now they like it. We have experimental students take numerical methods and theory students take experimental methods.
- AP: At Wayne State we have set up different tracks depending on specialty and eliminated classical mechanics.
Proposals (CC):
I would like to propose 3 things that the report from this meeting should recommend:
(1) The core curriculum should be updated to be relevant for today, but each department
should decide how to do that themselves.
(2) We should encourage interdisciplinarity in graduate electives.
(3) There should be interdepartmental colloquia separate from the standard department
colloquia and outside of the required curriculum.

Question:
What will the graduate curriculum look like in the future?
• It is unavoidable that we’ll have different tracks.
• Not necessarily. I think we have agreed what the core is: E&M, quantum mechanics, and
statistical mechanics.
• (RK): I don’t think we have agreed. I still think classical mechanics is important.

Comment:
Why should we agree? Different departments will do different things; we don’t have to be
clones of each other.

Final Comment:
It’s okay to disagree. (applause)

Scribe: David Reid
    Department of Physics
    University of Chicago
    5720 S. Ellis Ave
    Chicago, IL 60637
dreid@uchicago.edu