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Proposals for major curricular changes

"More physical fundamentals" suggested by Chang Liu

I think the EE and CE curricula should be considered separately. I advocate strong change of the EE curriculum.

For the EE curriculum, I think we should gear up for a major change (not minor local optimization). The reason is that nanotechnology will fundamentally change the way we make materials, change the materials as we know today, change devices, and ultimately change physical science. Our students can not be expected to be taught with a 20th century curriculum and be expected to be leaders in the 21st century.

I strongly advocate that we should train leaders not specialists. Some would argue that we need to cater to the companies who demand us to teach more bifurcated, specialized info., but I think good schools need to set examples. We can not put ourselves at a league below MIT, Stanford, and Caltech.

We should add four required courses at 2nd and 3rd year. These required courses should be carefully picked, but could include:

- quantum mechanics
- optics and photonics
- organic chemistry
- inorganic chemistry
- analytical chemistry
- fundamentals of materials
- thermal dynamics
- solid state devices

These courses are not just materials-centric courses, they are the courses that glue first year physics/math knowledge together without forcing our students to specialize. These are the "repetitions" that our students need. These are the fundamentals our students need to be leaders, and these are the courses that will set our department apart from the rest of the EE departments.

We should reduce our required/semi-required courses to make room for these four courses. Some professors who are used to teaching specialized courses will teach fundamental courses once in a while.

"Coherent Core" suggested by Doug Jones, Erhan Kudeki

Our discussions of concerns seemed to yield several clusters of issues:

- Advanced material targeted at seniors; Gaps between the core and advanced core
- Overly specialized material in core courses; too much material in core courses; educational efficiency may be poor; students may lack time to absorb key ideas as we rush to include specialized information
- Our education may be too specialized, rather than fundamental; potential conflict between training specialists and teaching leaders; the "specialist" mindset permeates our department and education

- not enough fundamental physical science

It may be possible to address most of these concerns through a substantial retuning of our required ccurses.

1. Move the advanced core to the junior level, in fact as well as in course number
2. Go through the content in all of the departmental required courses to identify the fundamental, minimal "must know" material and trim out less essential specialty material, to ask whether these course still belong in the core, and to consider repackaging of material between such courses.
3. Consider increasing flexibility (and perhaps more hours by making our required core more efficient and less specialized) in our technical electives to allow students to take more fundamentals, more biology, or pursue alternate "leadership" paths

Possible strengths of this approach: The first item may allow us to address the gap between the core and the advanced core and make those courses serve more as the "gateway" courses they were originally intended to be. The second item can address the over-specialization problems, the educational efficiency, and hopefully the "can't see the forest for the trees" problem of students not grasping the big ideas and fundamental concepts. As part of that exercise we should thoroughly visit the "what every EE or CompE needs to know" question. The third item may allow some students to pursue more "fundamental" or "leadership" paths, while allowing others to pursue more traditional specialties. It may be important to note that our department alone produces about one percent of the total number of electrical and computer engineering graduates in the entire nation, so it may be important that we provide "full-service" curricula that well serve many types of engineers.

This somewhat incremental approach may involve the least amount of work, for both this committee and our faculty, to improve our curriculum.

Possible drawbacks of this approach: This approach would not fully address Chang Liu's concerns and only indirectly addresses the "leader" issue. The incremental approach is unlikely to result in a profound change of approach or culture, so it presumes that a "tune-up" rather than a fundamental rethinking is required. It only indirectly addresses the concerns about weaker students.

Levinson commentary

We can argue endlessly about what material is "fundamental" and what is "necessary". At the end of the day it is impossible to satisfy everyone's concept of "required" material within the constraints of a nominal four year program. I think the current approach is about as good as it can be in this respect. Certainly we can refine here and there but the basic curriculum is OK for our student's immediate needs. The approach I think we can usefully take to the question is to recognize that ECE is a mature discipline and this is where the problem comes in. Because it is mature, we are obliged to teach all the basics. But if we do only that, then maturity will become obsolescence. So we need to ask where are the frontiers. Chang Liu has made one sensible suggestion. Here's another. I think the next two waves of innovation in ECE will come first in biology and then later in cognitive science. In both cases the contribution ECE can make is the mathematical formalization of whaat are presently two descriptive and empirical disciplines. I would like to see the development of two senior level survey courses to address these new fields.

Plans at other institutions

Description of MIT changes.

To summarize, they are going from a rather large set of required fundamental science courses to a more

flexible "choose N from a list" approach, arguing that "there is just too much information to cover it all." Other changes include restricting AP credit and encouraging a semester abroad. <% CreatePageFoot %>