

Undergraduate Curriculum Issues: Upper Level Courses

Breakout Session II

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Issue #1: How to offer more than one semester of quantum and E&M with limited faculty

1. A special topics course can be used to cover multiple advanced areas (e.g., electromagnetism, quantum mechanics, statistical mechanics) in a single class, possibly using overarching principles and techniques to unite them.
2. The consensus was that a single semester of electrodynamics and quantum mechanics should provide adequate preparation for graduate school.

Issue #2: Computational Physics in Curriculum

1. When it is difficult to integrate computation throughout the curriculum, it is often easier to create a single course devoted to computational physics.
2. In order to integrate across the curriculum, it is important to adopt standard software (e.g., Maple or Mathematica) that would be used in all courses, including calculus.
3. LabView has proven to be useful in advanced labs.
4. Lego robots are also useful to introduce programming.

Issue #3: Teaching Mathematical Methods

1. In many schools, the math department teaches their courses with more emphasis on proofs than calculation, which hampers student performance in physics courses.
2. Many schools have created a mathematical methods course, which helps ensure students learn important mathematical techniques useful to solve physics problems.
3. The *Mathematical Methods in the Physical Sciences* by Mary Boas is the most commonly used text.
4. It is important to teach a math methods course as early as possible—sophomore and junior years.
5. A math methods course has been observed to accelerate upper-level physics courses since less time is required to review needed mathematics.
6. Some schools have used integrated introductory physics and calculus courses, with mixed success.
7. It is sometimes useful to see math applied in physics first, and then followed by a more rigorous treatment in a math course.

Issue #4: Undergraduate Research

1. Faculty Teaching Credit:
 - a. A few schools give credit to faculty directing research, but most do not.
 - b. Some schools allow faculty to “bank” credits for guiding research students, allowing for release time after sufficient number of credits have accumulated.
 - c. An independent studies course, rotated among faculty, is sometimes used.
2. Additional reasons for obtaining credit for guiding research:
 - a. Informs administration of what is going on and emphasizes its importance.
 - b. Encourages theorists to take on students
3. In some schools, students may write an honors thesis.
4. A course in research (learning to write papers, give short talks, etc.) may be taught.
5. Journal clubs are a good way to introduce students to research.