

To: Dan Stein, Dean for Science
Cc: Matthew S. Santirocco, Dean of the College
Maria Shamis Hish, Associate Dean for Science
Faculty, Department of Physics
From: David W. Hogg, Director of Undergraduate Studies, Physics
Andy Kent, Director of Graduate Studies, Physics
Dan Zwanziger, Chair, Physics
Subject: laboratory, recitation, grading, and graduate TA policy
Date: 2009-06-05

Executive summary: In this memo we outline pedagogical and practical considerations in our use of laboratories, recitations, and grading in Physics Department courses. We distinguish six different categories of classes, and propose using dedicated recitations for only one of these categories. Laboratory supervision and heavy grading responsibilities are utterly essential parts of our course support; we provide our plans for balancing these needs with the educational and professional development goals of our graduate program.

This document has been shared with the Faculty of the Department, but it has not been voted upon; it does not necessarily represent the opinion of a majority of the Department Faculty.

General remarks: Among all the natural sciences, physics has the most indirect relationship between the experimental or epistemological basis of knowledge and the fundamental mechanism (which is often subatomic, near absolute zero, or cosmologically distant). For these reasons, mastering abstract concepts is important to a greater degree in physics than in other sciences. A large body of research has shown that—at all educational levels—these abstract concepts can only be learned through their application in challenging problem-solving and challenging laboratory experiments.

The pedagogical mission of the Department, therefore, requires the generous support for the giving, execution, and evaluation of rich and challenging problem sets and laboratory experiments. These pedagogical issues and this conclusion are independent of the the source of our support for problem-solving and laboratory experiments, the courses we offer and how we structure our curriculum, and the people with whom we staff those course components.

Specifics of course support: There are six categories of courses taught by the Dept:

- (a) introductory undergraduate Majors' courses,
- (b) advanced undergraduate Majors' courses,
- (c) introductory graduate courses,
- (d) advanced graduate courses,
- (e) MAP courses, and
- (f) non-MAP, non-Majors' courses (essentially Minors' courses).

We comment on these categories as follows:

- Categories (a,b,c) have enormous problem-set loads per student, roughly 10 pages per week per student. We don't see any way to get around human grading for these, because they involve very subtle issues and written explanations, and the students deserve detailed feedback. They also benefit from the motivation of grading.
- Categories (a,b) may expand a bit in this direction as we introduce some writing (writing in the discipline) into the undergraduate curriculum.
- In category (d) we do not intend to have any problem set and homework support beyond what the faculty member provides.
- In categories (a,b,c,e), associated laboratories must be supervised at a level of no more than 22 students per section or 44 per TA (supervising two sections). We managed to squeeze one more bench into each room to make 11 benches, and now the size of the laboratory sections is strictly limited by the area of the instructional laboratory rooms and cannot be further increased without larger rooms. It would also require substantial new purchasing of laboratory equipment. Besides, it is not clear that a single individual can adequately supervise more than 22 students simultaneously operating unfamiliar equipment. Currently these laboratories also require of the students about 10 pages per week per student.
- In categories (e,f) we are experimenting with online and electronic homework for non-laboratory content. This experiment is extremely disappointing (for reasons that go beyond the scope of this document). We would rather have experts grading homework, but we are willing to live with the electronic methods here for now, given limited resources. It is also possible that we could reduce our offerings in categories

(e,f); right now we offer more MAP courses than any other science department, and we teach something like 2000 bodies per year in these service courses.

- The course offerings in category (f) could, in principle, be reduced without loss to the MAP or Majors programs. This would make the Physics Minor a near impossibility, but it would somewhat reduce our grading requirements.
- Category (a) has a special status because we have made our introductory sequence (Physics I, II, III, CQW, Math Physics) extremely challenging and very much a departure from standard physics curricula and the students' incoming expectations. This departure means that the students face qualitatively different challenges here than in the later classes of the Major. Furthermore, the students who follow this sequence are exceptional undergraduates at NYU; all the courses are taught at an Honors level, and much is demanded. For all these reasons, we feel that these courses above all others deserve additional support in which the students see the material from multiple viewpoints, obtain peer support from one another, and receive individual attention. We believe the new attention we have given these courses has played a large role in the recent increase (by a factor of two) in the number of Physics Majors over its traditional value. This support in the introductory classes is also important in maintaining and improving our success in supporting underrepresented populations in Physics.

Graduate students in the classroom Nothing in the above requires that course support be supplied by graduate students. It could be supplied by faculty (if consistent with their course loads) or adjuncts or even advanced undergraduates. That said, graduate students and advanced undergraduates *do* have some now well-researched and well-documented advantages (*peer instruction*) in reaching students who need help and facilitating classroom debate and group problem-solving.

If course support *is* to be supplied by graduate students, we must apply important general considerations that the graduate student teaching workload be balanced and fair, and that their classroom experiences *must* help them towards their educational, scientific, and professional goals.

Pure grading—with no contact with the students—is not a graduate stu-

dent responsibility that helps enormously with professional development. (It is not irrelevant, because it exposes them to student misconceptions, but it is not nearly as rich a channel as classroom, problem session, or face-to-face interactions.) For these reasons, we ask our graduate-student graders to *also* hold office hours or help sessions, to give the students feedback, and often to write up detailed solutions to the problem sets. These activities are pedagogical and writing-oriented and beneficial to the graduate students; they also take substantial time.

These considerations lead to the following policies:

- When courses are very small, we will not assign any grader at all, and certainly no recitation instructor.
- When courses are pretty small but still require large grading loads (more than 150 pages of grading per week), we will assign some kind of grading support, in the form of (at least) one half of one GS TA or equivalent in adjunct or faculty.
- Given the expectation of homework sessions, feedback, office hours, and writing, we won't ask one GS TA to grade more than 400 pages per week. Even that is a substantial load with the other responsibilities.
- GS TAs will *only* be given assignments of "recitation instructor" (that is, primarily a teaching role that does not in itself involve grading) in courses of category (a) above, and even here only when there are more than 44 students per class. Otherwise, the role of the "recitation instructor" will either go unfilled or be considered equivalent to one half of one GS TA assignment.
- We will assign one GS TA to no more than two laboratory sections of 22 students each; that is, one laboratory GS TA for every 44 students. These assignments involve close to 400 pages per week of grading as well as the laboratory supervision responsibilities.

Other comments and considerations The Department will sometimes schedule recitations in SIS even if we don't plan to staff them. This permits us to provide scheduled space and time for problem-solving sessions, peer instruction, and faculty interaction.

The Department will propose a pay scale system for hiring adjuncts to do grading that is *not* based on official contact hours. This is necessary in any future in which we use adjuncts in grading or laboratory roles.