DEPARTMENT OF PHYSICS 2013-14 ASSESSMENT REPORT

PHYSICS MAJOR LEARNING OBJECTIVES

Students graduating with a degree in Physics will be able to:

A. Understand the fundamental principles of physics and be able to apply these core ideas to analyze physical processes;
B. Apply quantitative reasoning and critical thinking to solve complex problems, both theoretical and experimental in nature;
C. Independently learn new technical subjects and skills;
D. Design and assemble experiments, quantitatively analyze the results using appropriate statistical procedures and tests of systematic errors, and draw meaningful conclusions;
E. Effectively communicate scientific ideas, both theoretical and experimental, to diverse audiences through written and oral presentations, both formal and informal;
F. Work effectively and inclusively as a member of diverse collaborations to solve problems.

RESULTS

seems.

Studies have shown that in a traditional well-taught lecture class, the FCI gain is measured to be around 20% while in a class employing a wide range of active eSt

Most test questions can be answered on the basis of a mastery of the first three years of undergraduate physics.

In Physics 2004 we use a subset of questions from the GRE test centered around topics that students should have familiarity with through the General Physics sequence (including Modern Physics, PHYS 2004).

2013 class average = 21% (percentile based on students applying for graduate study) N = 28

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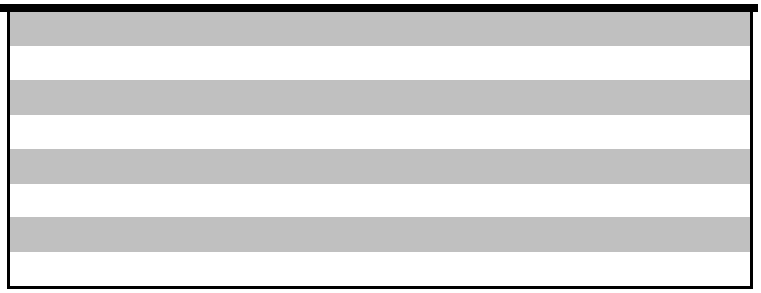
Comparison of Physics 2004 (2nd year) to Physics 4950 (4th year) results



Summary of assessment results from nationally normed exams

A Department goal is for our students to achieve the national average on all nationally normed exams (This goal, in the case of the GRE exam, may be aspirational as we are comparing all our students to a subset of students who applied to graduate school in Physics.)

The sobering results of our assessments are that we are consistently falling short of our goals for our students There is a persistent 10+ point gap between the overall class performance on the FCI in Physics í ì ì í v š Z l v } Á o P o À o (} Œ ^ µ v Œ • š v] v P X _ d Z P ‰ š Á v } µ the BEMA and the level for understanding in Physics 1003 is around 20 points } µ Œ (µ o š Ç [• v • š µ v š • [Œ] š U š Z] u ‰ Œ } À our Senior Physics Majors is at or above the baseline for traditional instruction.

In both Physics 2004 and Physics 4950 performance of our students falls short of our goals, and in fact the performance of the 4th-year students in Physics 4950 shows little improvement compared to the 2nd-year students in Physics 2004. On the other hand, one should be careful about reading too much into the results as relatively few students (< 10) have taken the exams each year.

The Department held a meeting of the tenure-track faculty on 10 September 2014 š } ^ o } • š Z o } } ‰ _ and strategize on what improvements might be made to curriculum and teaching methods.

It was the opinion of the faculty that based on these results, the students overall were suffering from a lack of a fund of knowledge about physics and had significant weaknesses in conceptual understanding and problem solving skills that needed to be addressed.

The following plans were adopted:

(1) Basic physics knowledge taught in the General Physics sequence (PHYS 1003, PHYS 2004) would now be emphasized throughout the upper-division curriculum by additional basic problems added on to homework assignments to give students extra practice at the basic concepts. This could be done without sacrificing the advanced instruction that is part of the present curriculum.

(2) We will no longer allow note sheets on upper division exams to further emphasize learning and remembering physics concepts, relations, and problem solving strategies to improve student [illegible] of physics knowledge.

(3) We will increase use of oral exams and in-class presentations of problem solutions, and peer-to-peer learning strategies, to further emphasize and practice accessing the fund of physics knowledge.

(4) We will continually emphasize throughout lower and upper division the Prepare-Solve-Assess strategy of problem solving.

(5) We will expand use of peer evaluation to help teach students how to evaluate their own work.

(6) In future years, the FCI and BEMA will be analyzed by subject area to specifically target what areas of instruction need most improvement.

Problem Sets and In-class Problems (individual & group, rubric-based assessment) (SLOs: A, B, C, E, F)

A core part of the Physics curriculum is learning to apply the concepts of physics to solve complex problems and present the solutions in written form, and sometimes in oral presentations. The problems are solved both individually and in groups. This core part of the curriculum, related to five out of our six SLOs, is evaluated with the following rubric.

Each problem is graded out of 5 points according to:

5 The student clearly understands how to solve the problem. Minor mistakes and careless errors can appear insofar as they do not indicate a conceptual misunderstanding.

4 The student understands the main concepts and problem-solving techniques, but has some minor yet non-trivial gaps in their reasoning.

3 The student has partially understood the problem. The student is not completely lost, but requires tutoring in some of the basic concepts. The student may have started out correctly, but gone on a tangent or not finished the problem.

1. Physics 2004

The fourth problem set of Modern Physics was assessed, with the following results:

2014 overall performance: 3.8/5.0, which is close to our goal of 4.0, which means that the students understand the main concepts and problem-solving techniques (but still have some minor gaps in reasoning).

Problem 1: 3.0/5.0 (On relativistic energy, most students understood but a few were confused).

Problem 2: 4.0/5.0 (On four-vectors, all students scored > 3 and demonstrated basic understanding).

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3. Physics 4002

Summary of assessment results from problem set rubrics

Lower division students in PHYS 2004 and upper division students in PHYS 3302 performed reasonably well on the long

Comparison between levels

Laboratory Notebook and Class Presentation (goal is an average of 4.5 or above in each area)

SUMMARY

(6) In future years, the FCI and BEMA will be analyzed by subject area to specifically target what areas of instruction need most improvement.

(7) We will analyze the utility of problem set solutions using BlackBoard analytics.

(8) We will develop assessment strategies for our Physics 2700 series and for our GE course offerings.