UNIVERSITY OF SAN FRANCISCO
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2015-2016 Assessment Plan Report

PROGRAM ASSESSMENT REPORT
AY 2015-2016

Report Date: **July 1, 2016**

School/College: **ARTS & SCIENCES**

Department/Program: **PHYSICS & ASTRONOMY**

Person completing the Report: **HORACIO E CAMBLONG**

1. **Overview Statement**. Assessment activities in the Physics major program were undertaken as planned during the AY 2015-2016, following the guidelines outlined in the "Program Assessment Plan." The implemented approach is summarized next.

   a. **Program Learning Outcomes.** Two Physics Program Learning Outcomes were assessed this academic year, within the scope of Program Learning Goal 1.
      - Program Learning Outcome 1 (a). Demonstrate mastery of the core concepts and general principles of physics.
      - Program Learning Outcome 1 (b). Demonstrate competent knowledge of the specific concepts, principles, and problems of each of the basic subfields and some applications in physics.

   b. **Generic Assessment Procedures.** The program learning outcomes above were assessed in the courses PHYS 110 (General Physics I), PHYS 210 (General Physics II), PHYS 240 (Modern Physics), PHYS 312 (Statistical and Thermal Physics), PHYS 330 (Quantum Mechanics), PHYS 340 (Optics) and PHYS 371 (Methods of Mathematical Physics). The whole process was organized at the departmental level with cooperation of all the instructors involved, and according to the Physics Assessment Plan for the three-year cycle 2015-2018. This plan provides precise procedural guidelines for data collection via embedded questions and/or multiple-choice exams, and for the evaluation of the gathered data against the assessment metrics. The data were stored electronically. The faculty members teaching these courses were responsible for the required data collection: Thomas Bottger (PHYS 110), Brandon Brown (PHYS 210 and 312), Seth Foreman (PHYS 240 and 340), and Horacio Camblong (PHYS 330 and 371).

2. **Assessment Procedures, Data Analysis, and Follow-ups**.
   a. **Specific Assessment Procedures.**
   Following the guidelines of our Physics Assessment Plan, the learning outcomes were

assessed by means of *embedded questions or equivalent direct measures:*

- Embedded problems in the final exams (or equivalent) were used for Learning Outcome 1 (a) in PHYS 110, 210, 240, 312, and 340. These were selected as representative, standard questions or problems with significant conceptual content, where the mathematical solution is only incidental to the underlying concepts. In addition, the whole set of multiple-choice questions on the final exams for PHYS 330 and PHYS 371 were assessed (the questions typically involve significant mathematical content and problem-solving skills, similar to the ETS Physics Major Field Test and/or GRE Physics Test).
- With similar conceptual emphasis and via embedded problems, Learning Outcome 1 (b) was assessed [overlapping with 1 (a) in most cases] in PHYS 312, 330, 340, and 371.

b. **Assessment Data Collection and Analysis.**
The learning outcomes were gauged with a *ternary metric system:* above average, average (benchmark standard), and below average---roughly equivalent to A range through B, B- through C-, and D-F range, respectively. It should be noticed that these are meant to be categories defined by comparison with the benchmark standard, regardless of the statistical course average for any given class section. In all cases, student performance was evaluated on the basis of a representative sample of embedded questions (as described above). The specific embedded problems and the cutoff numerical grades for each category were selected via a routine discussion among the faculty involved. The results are summarized below:

- PHYS 110: A representative sample of five embedded questions was extracted from a multiple-choice final exam. The following results were compiled for a total of 53 students: Above Average = 44 students; Average = 9 students; Below Average = 0 students.
- PHYS 210: A representative sample of embedded questions was extracted from one problem on a midterm exam and two problems on the final exam. The following results were compiled for a total of 31 students. For the midterm exam: Above Average = 21 students; Average = 10 students; Below Average = 0 students. Above Average = 23 students; Average = 8 students; Below Average = 0 students.
- PHYS 240: A representative sample of embedded questions was extracted from two different problems. The following results were compiled for a total of 5 students: Above Average = 2 students; Average = 3 students; Below Average = 0 students.
- PHYS 312: A representative sample of embedded questions was extracted from a

comprehensive midterm exam (in lieu of the final, which was replaced by paper presentations); the sample included four multiple-choice questions and questions from two problems. The following results were compiled for a total of 15 students. Above Average: 11 students; Average: 3 students; Below Average: 1 student.

- PHYS 330: All the fifty-five questions on a multiple-choice final exam were used for this assessment sample. The following results were compiled for a total of 8 students: Above Average = 4 students; Average = 3 students; Below Average = 1 student.
- PHYS 340: A representative sample of embedded questions was extracted from one problem on the final exam. The following results were compiled for a total of 11 students: Above Average = 7 students; Average = 2 students; Below Average = 2 students.
- PHYS 371: All the forty-four questions on a multiple-choice final exam were used for this assessment sample. The following results were compiled for a total of 7 students: Above Average = 3 students; Average = 4 students; Below Average = 0 students.

c. **Follow-Up Discussion and Decision-Making.**

Three faculty meetings scheduled during the academic year addressed various aspects of assessment: our official assessment plan and the results of this assessment cycle. In addition, follow-up discussions are planned for the 2016-17 Physics Department meetings. So far, the following conclusions have been drawn, with appropriate specific steps to be taken where applicable:

- All in all, the results of the assessment activities show a relatively high level of performance by most students, with an excellent command of *basic conceptual skills*---both for lower- and upper-division level physics courses.
- *No significant curricular changes are planned/required for AY 2016-17.* Notice some recent, minor changes discussed below.
- The Department has not yet made a decision on the issue of the possible direct use of the *ETS Physics Major Field Test* as an assessment tool. However, steps in this direction have been taken by an ongoing exploration of the role played by ETS/GRE-style questions in several targeted courses; this approach will continue during AY 2016-17.
- In the latest 3-Year Assessment Plan (2015--2018), “targeted curricular questions” were proposed for each year of this 3-year cycle. We specifically addressed the question: ``Is the curriculum properly addressing the all-important framework of dimensional analysis (units, dimensions, and scales)? We found that students are learning this crucial approach properly at all levels (starting with the

introductory PHYS 110).

3. **Program Assessment and Curricular Changes:**

NO CHANGES have been made to the Program Assessment Plan this year (since the latest submission in December 2015).
Incidentally, the Physics Major program has been slightly modified (already approved by the Curriculum Committee) with two minor adjustments that had been years in the making. One formal change was the implementation of the four-unit Upper-Division Laboratory (PHYS 341 or 342) in lieu of a two-unit requirement; in practice, this had been implemented recently (as an ongoing test) by de facto scheduling. The other change was the replacement of Computational Physics I (PHYS 301) by the more introductory Computer Science course CS 110; the goal here is to provide a more basic (elementary) foundation while keeping PHYS 301 as an elective and part of the recently approved Computational Physics Minor.