ENGINEERING PHYSICS MINOR—ASSESSMENT REPORT
FOR ACADEMIC YEAR 2016-2017

DEPARTMENT OF PHYSICS & ASTRONOMY
UNIVERSITY OF SAN FRANCISCO

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1. PHYSICS & ASTRONOMY DEPARTMENT MISSION STATEMENT

The mission of the Physics & Astronomy Department is to provide our students with the fundamental knowledge and the practical tools of a rigorous physics education that will help them be players and leaders in shaping a more humane world. The Physics program is implemented via a comprehensive coverage of experimental, theoretical, and computational physics, and by combining coursework together with on- and off-campus research and exposure to cutting-edge equipment and laboratory techniques. This rigorous training prepares students for careers and/or graduate studies in any discipline within fundamental or applied science (physics, astronomy, mathematics, chemistry, biology, etc); in any of the standard engineering fields; in education; in medicine and related disciplines; and many other fields, such as law, financial analysis, or positions in the high-technology sector of the global economy.

2. ENGINEERING PHYSICS MINOR LEARNING OUTCOMES (PLOs)

1. - **PLO 1 (a).**
     Demonstrate competent knowledge of the core concepts, principles, and applications of *electronics*.
   - **PLO 1 (b).**
     Demonstrate competent knowledge of the core concepts, principles, and applications of *computational physics*.
2. - **PLO 2.**
     Conduct experiments for a comparison with physical models and theories, and *examine* the results with the statistical methods of error analysis.

3. ENGINEERING PHYSICS MINOR ASSESSMENT IMPLEMENTATION

3.1 Overview Statement.

Assessment activities in the Engineering Physics Minor program were undertaken as planned during the AY 2016-2017, following the guidelines outlined in the Three-Year Program Assessment Plan (December 2015), supplemented by adjustments to the Learning Outcomes (March 2017).

The timetable for the different learning outcomes has followed the planned framework: AY 2015-2016: LOs 1 (a) & 1 (b); AY 2016-2017: LO 2; AY 2017-2018: LO 3.

The implementation for AY 2016-2017 is summarized next.

3.1.1 Program Learning Outcomes.

The Engineering Physics Minor Program Learning Outcome assessed for this one-year period, involves experimental procedures and analysis.

- **PLO 2.**
  Conduct experiments for a comparison with physical models and theories, and *examine* the results with the statistical methods of error analysis.

3.1.2 Generic Assessment Procedures.

The program learning outcome above was assessed in the following courses: PHYS 110 (General Physics I), AND PHYS 210 (General Physics II). 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 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: Seth Foreman and Milka Nikolic (PHYS 110 and 210). And the team work was coordinated by Horacio Camblong.

3.2 Assessment Procedures, Data Analysis, and Follow-ups.

3.2.1 Specific Assessment Procedures.

Following the guidelines of our Physics Assessment Plan, the learning outcomes were assessed by means of the laboratory data analysis and interpretation, and questions associated with laboratory procedures as presented by the students in their laboratory workbooks and reports. The results were evaluated by the overall presentation of the experimental procedures and data collection, combined with the detailed statistical analysis and interpretation of the experimental data.

3.2.2 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 laboratory experiments (usually one or two lab experiments per course). The specific labs 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 Lab, Fall 2016:

  Two representative lab experiments were selected: Lab 5 "Forces and Equilibrium" and Lab 9 "Sound." They both which combine fundamental physics with a careful data analysis (including error analysis of the collected data). The selected experiments provide the essential ingredients for an effective learning outcome assessment.

  The assessment procedure involved 4 separate laboratory sections, for a total of 53 students. Of these, 1 student was absent in both labs; for the other 52 students who participated in both lab experiments, the results were graded and compiled as follows.

  Above Average: 45 students;
  Average: 7 students;
  Below Average: 0 students;
  Absent: 1 student

  Note on rubrics and grading: Lab reports were graded out of 10 points: 4 points available for full participation and "completeness;" 3 points available for the questions embedded in the spreadsheet templates; 3 points available for "technical details" (like significant figures, units, plots, etc.)

- PHYS 210 Lab, Spring 2017:

  A representative lab experiment was selected: Lab 9 "AC Circuits (RC Circuits and the Oscilloscope)." It combines fundamental physics with a careful data analysis (including error analysis of the collected data). The selected experiment provides the essential ingredients for an effective learning outcome assessment.

  The assessment procedure involved 2 separate laboratory sections, for a total of 34 students. Of these, 1 student was absent; for the other 33 students who participated in the lab experiment, the results were graded and compiled as follows.

  Above Average: 26 students;
  Average: 7 students;
  Below Average: 0 students;
  Absent: 1 student

  Note on rubrics and grading: Lab reports were graded out of 10 points: 4 points available for full participation and "completeness;" 3 points available for the questions embedded in the spreadsheet templates; 3 points available for "technical details" (like significant figures, units, plots, etc.)

3.2.3 Follow-Up Discussion and Decision-Making.

Four faculty meetings scheduled during the academic year addressed various aspects of assessment: our official assessment plan, the learning outcomes, and the results of this assessment cycle. In addition, follow-up discussions are planned for the ongoing 2017-18 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 laboratory skills.
- No significant curricular changes are planned/required for AY 2017-18. But notice some recent changes discussed below.
- 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:
  - Learning Outcome 2: Is the curriculum properly addressing the systematic use of the theory of errors in both lower- and upper-division experimental physics?

  We found that students, both lower- and upper-division, are learning the basic statistical tools and acquiring the data-analysis skills to interpret a variety of experiments over a broad range of physics fields.
- All the courses involved had undergone significant revisions partially driven by the previous three-year assessment cycle. The revamping of laboratory experiments in PHYS 110 and 210 reflected these improvements (as noted by the instructors and confirmed by the overall excellent results).