UNIVERSITY OF SAN FRANCISCO | College of Arts and Sciences

ASSESSMENT REPORT
FOR ACADEMIC YEAR 2021-2022

ENGINEERING PHYSICS MINOR

Department of Physics & Astronomy

University of San Francisco

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1 LOGISTICS, MISSION STATEMENT & PROGRAM LEARNING OUTCOMES

1.1 PHYSICS & ASTRONOMY CONTACT PERSON (FACULTY ASSESSMENT COORDINATOR).

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1.2 PHYSICS & ASTRONOMY DEPARTMENT MISSION STATEMENT

No changes were made to the program mission statement since the last assessment cycle in November 2021.

> 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.

1.3 ENGINEERING PHYSICS MINOR LEARNING OUTCOMES (PLOs)

No changes were made to the program learning outcomes (PLOs) since the last assessment cycle in November 2021.

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.

1.4 CURRICULAR MAP LINKING THE ENGINEERING PHYSICS MINOR LEARNING OUTCOMES AND THE RELEVANT PHYSICS COURSES

In the curricular map below, the check-mark symbol ✓ indicates the applicable PLOs for each course.

PLOs ⟹ **PHYS** **courses** ⇓	**PLO 1 (a)** **Demonstrate** knowledge/applications electronics	**PLO 1 (b)** **Demonstrate** knowledge computational physics	**PLO 2** **Conduct and examine** experiments + error analysis
PHYS 110 (General Physics I)			✓
PHYS 210 (General Physics II)			✓
PHYS 261 (Electronics)	✓		✓
PHYS 262 (Intro Digital Electronics)	✓		✓
PHYS 301 (Intro Scientific Computation)		✓	
PHYS 302 (Sci. Comp/Machine Learning)		✓	

1.5 PROGRAM LEARNING OUTCOME(S) ASSESSED FOR THE ACADEMIC YEAR 2021-2022

The Engineering Physics Minor Program Learning Outcome assessed for this one-year period involves one of the major learning goals relevant to the physics program: 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.

1.6 ASSESSMENT SCHEDULE

The last Academic Program Review (APR) of Physics & Astronomy was conducted in Spring 2018. For the Engineering Physics Minor discussed in this report, the following timetable of Program Learning Outcomes has been followed thorough last academic year:

- AY 2018-19: PLO 1 (a)
- AY 2019-20: PLO 1 (b)
- AY 2020-21: PLO 1 (b)
- AY 2021-22: PLO 2

We anticipate reassessment of these PLOs until the next APR according to a flexible timetable that will depend on internal factors involving course offerings (as some courses may not be offered every year) and ongoing departmental discussions on the assessment procedures. For this academic year, we are already collecting data for next year's report as follows:

- AY 2022-23: PLO 1 (b)

2 METHODOLOGY

2.1 Methodology.

Assessment activities in the Engineering Physics Minor program were undertaken as planned during the AY 2021-2022, following multiyear departmental guidelines.

2.2 Generic Assessment Procedures.

The program learning outcome PLO 2 above was assessed in the following course: PHYS 110 (General Physics I). The process was organized at the departmental level with cooperation of all the instructors involved and our Program Assistant, and according to our multiyear departmental guidelines. The data were stored electronically. The faculty member teaching

the lecture or main sections of this course was responsible for the required lab-instructor coordination and data collection of the students' work products: Milka Nikolic; moreover, the grading of the work products was conducted directly by the instructors of the multi-section lab components (Milka Nikolic and Seth Foreman). In addition, the overall logistics and final re-grading of the work products was conducted by Horacio Camblong.

2.3 Assessment Procedures and Data Analysis.

The relevant learning outcome was assessed by means of direct measures consisting of questions for specific laboratory exercises. The questions required understanding of the experimental procedures and interpretation of data, in addition to specific knowledge of the concepts and principles of physics. The lab exercises were properly selected to provide the essential elements for an effective PLO 2 assessment.

The learning outcomes were gauged with the *4-level scale system* listed below. It should be noted that these 4 levels are meant to be categories defined by comparison with the minimum benchmark standard, defined as "average," regardless of the statistical course average for any given class section. This classification refers to the level of proficiency of the skill and knowledge set involved in the learning outcome.

- Outstanding = Full Mastery. This represents superior performance, with an almost complete command of the relevant skill and knowledge set.

- Proficient = Partial Mastery. This represents basic, solid performance that reflects a level of achievement where errors or omissions only affect the final results in a minimal way.

- Satisfactory = Meets Expectations. This represents performance that meets expectations as benchmark standard set up to correspond to an overall, satisfactory outcome (involving most parts of the assessed problem, question, or project), but allowing for errors or omissions whose correction would otherwise lead to considerable performance improvement (i.e., not reaching partial mastery, but showing a minimum acceptable level for most of the relevant skills).

- Inadequate = Unsatisfactory Level. This mark does not necessarily imply complete failure to perform on the given outcome, but involves serious gaps in understanding and/or problem-solving outcomes for the relevant skill and knowledge set.

3 RESULTS & MAJOR FINDINGS

The results for the course selected for assessment are summarized below:

- PHYS 110 (General Physics I) Lab, Fall 2021:

  A representative lab experiment was selected: Lab 3, "Falling with (and without?) air resistance." This lab combines fundamental physics with detailed data analysis (including error analysis of the collected data) in the context of one of the most important examples of a universal law (free fall from universal gravitation). This selected experiment provides the essential ingredients for an effective learning-outcome assessment.

  The assessment procedure involved 3 separate laboratory sections, for a total of 35 students. Of these, 1 student was absent; for the other 34 students who participated in both lab experiments, the results were graded and compiled as follows.

  Number of Participants: 34 students;
  Outstanding: 30 students (88.2%);
  Proficient: 4 students (11.8%);
  Satisfactory: 0 student (2.2%);
  Inadequate: 0 students (0%).

  Note on rubrics and grading: Lab reports were graded with the following parameters: full participation and "completeness" of the reports; answering of questions embedded in the spreadsheet templates; and "technical details" (data analysis, significant figures, units, plots, etc.)

4 CLOSING THE LOOP

4.1 Follow-Up Discussion and Decision-Making.

Two Physics & Astronomy faculty meetings addressed various aspects of assessment. The discussions included a review of our assessment plan, the learning outcomes, and the results of this assessment cycle. In addition, follow-up discussions are planned for the ongoing 2022-23 Physics Department meetings.

The following conclusions were drawn:

- All in all, the results of the assessment activities show a very high level of performance

by all students, with an excellent command of the experimental-physics skills relevant for the engineering-physics-minor PLO 2.

- The assessment outcomes of this cycle are also consistent (qualitatively and quantitatively) with the assessment outcomes of earlier academic years.

- In our departmental discussions of assessment activities and plans, we have often addressed "targeted curricular questions" that we consider central to the goals of our major and minor programs. One question relevant to this specific report has been:

  – 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 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.

- We are using a model that has been successful in our Physics & Astronomy programs for several years. The External Program of the Academic Program Review conducted in Spring 2018 praised our assessment program as follows.

  > "The overall P&A assessment program is well designed and appears mature. The probes are robust and appropriate, and the reports provided by the department are easy to interpret and contain useful information about student performance. P&A does very good work in many areas and students are a dominant focus in much of that work. ... The assessment program for P&A is more than sufficient, and it is managed extremely well."

  This is consistent with our own self-evaluation.

- No significant curricular changes are planned/required for AY 2022-23.

  It should be noted that the physics program has adjusted well to the constraints of the ongoing pandemic, and the PHYS 110 lab in Fall 2021 was conducted online. For now, no further adjustments are needed.