ASSESSMENT REPORT

FOR ACADEMIC YEAR 2019-2020

ENGINEERING PHYSICS MINOR

Department of Physics & Astronomy

University of San Francisco

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Submitted by Prof. Horacio E. Camblong

camblongh@usfca.edu

1 LOGISTICS, MISSION STATEMENT & PROGRAM LEARNING OUTCOMES

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

Name: Professor Horacio E. Camblong, Email: camblongh@usfca.edu

1.2 PHYSICS & ASTRONOMY DEPARTMENT MISSION STATEMENT

No changes were made to the program mission statement since the last assessment cycle in November 2019.

> 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 2019.

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 2019-2020

The Engineering Physics Minor Program Learning Outcome assessed for this one-year period involves one of three major learning goals relevant to physics and astronomy: proficiency in the basic subfields of physics and astronomy, as well as areas of application.

- **PLO 1 (b).**

  Demonstrate competent knowledge of the core concepts, principles, algorithmic methods, and applications of *computational physics*.

2 METHODOLOGY

2.1 Methodology.

Assessment activities in the Engineering Physics Minor program were undertaken as planned during the AY 2019-2020, following multiyear departmental guidelines.

2.2 Generic Assessment Procedures.

The program learning outcome PLO 1 (b) above was assessed in the following course: PHYS 301 (Introduction to Scientific Computation). 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 relevant course was responsible for the required data collection and grading of the students' work products: Xiaosheng Huang (PHYS 301). 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 through a final computational project that was evaluated by a number of direct measures. These involved functionality of the program (80%, including performance of the basic functions and pattern recognition) and efficiency and software carpentry (20%).

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 301 (Introduction to Scientific Computation), Spring 2020:

  This course is an in-depth introduction to the fundamentals of scientific computation, with emphasis on computational physics.

  The selected work product is a computational physics project involving face detection and recognition, using machine-learning techniques implemented with the program Python. One of the objectives of this project is to show that an important aspect of the pattern recognition problem (digits, characters, faces) is image preparation ("preprocessing")—this involves an array of useful computational techniques whose successful completion provides an excellent test of this learning outcome PLO 1 (b).

  All the students participated in the lab experiment, and the results were graded and compiled as follows.

  Number of Students: 19;

  Outstanding: 16 students (84.2%);

  Proficient: 2 students (10.5%);

  Satisfactory: 0 students;

  Inadequate: 1 student (5.3%).

Note on rubrics and grading: The project was evaluated based on (i) functionality (80%); (ii) efficiency and software carpentry (20%).

(Functionality includes pattern recognition programming, interpretation of data, and accuracy. Efficiency and software carpentry includes following documentation; code structure and clarity, as well as presence and clarity of docstrings and comments; and code efficiency, avoiding unnecessary code repetition.)

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 2020-21 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 computational-physics skills relevant for the engineering-physics-minor PLO 1 (b).

- 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:

  - Are physics majors proficient in problem-solving techniques for "complex problems" (involving multi-step tasks)?

  This is equally relevant for the engineering physics minor, and the types of projects it involves. From the assessment of this learning outcome, we found that students are learning the basic tools to solve a variety of problems over a broad range of physics fields, and with all degrees of complexity. In this instance, the emphasis was on computational techniques relevant for complex problems.

- 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 2020-21. It has also been agreed that the ongoing pandemic creates additional constraints and challenges that far exceed the boundaries of a regular assessment plan—for now, no further adjustments are needed.