Annual Departmental Assessment Report

Department or Program: ***Physics***
Academic Year of Report: ***2019***
Department Contact Person for Assessment: ***Scott Fisher, Director of Undergraduate Studies***

Section 1: Learning Objectives Assessed for this Report

Desired broad outcomes for UO physics baccalaureate recipients include:

1. Knowledge of principles and concepts for specific core subject areas listed below.
2. Ability to apply principles and concepts to analyze problems within specific core areas.
3. Capability with quantitative methods appropriate for the core areas.
4. Ability to analyze and interpret quantitative results.
5. Experience with integration of concepts: analysis of complex problems cutting across multiple core areas.
6. Ability to collect and appropriately analyze data working independently and in collaboration with others (experimentation; data collection, reduction and analysis; model-based computation including simulations and inversion of observations; and literature research using basic and state-of-the-art technology).
7. Ability to communicate Physics concepts and research results orally and in writing.
8. Familiarity with current developments in physics.

To achieve these outcomes, the undergraduate major curriculum requires coursework with nationally-standard coverage of the core subject areas. As specific content objectives for the core areas, students who complete the department-based courses should:

1. have a working knowledge of classical mechanics and its application to "standard" problems such as central forces and rotational dynamics;
2. understand the principles of special relativity and have a working knowledge of its application to the mechanics of particles;
3. have a working knowledge of basic electrostatics, electrodynamics, and magnetism leading to the development of Maxwell's equations;
4. have a working knowledge of geometrical and physical optics;
5. have a working knowledge of electrical circuits and their applications;
6. have a working knowledge of basic thermodynamic principles and the relation of statistical mechanics to them;
7. have a working knowledge of elementary quantum mechanics and its application to the explanation of atomic structure and atomic spectroscopy;
8. have basic skills in laboratory practice including a working knowledge of data analysis, computer interfacing, scientific computing, and graphical presentation of results.

Until the start of Fall 2019 the major was organized into three tracks to graduation:

1. The standard physics option, which is intended to prepare students for graduate school in physics or a related discipline, and which combines advanced lecture and laboratory courses.
2. The applied physics option, which is intended to prepare students for careers in industrial research and development, and which combines some lecture courses with a heavier load of laboratory courses.

3. The general physics option, which is designed for training middle-school and high-school teachers, and which will combine some physics classes with classes in other science departments and optionally the UO School of Education

As of Fall 2019, the PHYS major has been re-tooled to:

- remove the previous "tracks" system
- broaden the choice of upper-division PHYS classes available to majors
- re-assess the upper-division requirements for the major

In the new system the first two years of the major remain unchanged. However, in the upper-division portion of the major, the new system does not contain any 'tracks'. Instead, the PHYS majors are presented with a menu of all currently available PHYS classes and they can choose their own path through them. The majors are required to take a total of 30 upper-division credit, of which at least 6 must be in designated lab classes. They have the option to take up to 12 credits of lab.

The department has provided new "flight paths" through the major – which are akin to the older tracks. However – we want o note that these are fundamentally different since they are not required paths through the major. They are only to help guide a student into broad areas of study.

All majors that started in Fall 2019 (and after) will beheld to the new requirements. The department has also allowed any student that was previously enrolled in the major to move onto the new 'no tracks' system if they desire.

Section 2: Assessment Activities

As in 2018, this year we continued to examine the efficacy of the track-based path through the major. Through this on-going analysis we discovered that this system was unnecessarily rigid and led to potential poor learning outcomes. For some students this track system led to an inability to take all the desired physics electives as they were "accessory" or otherwise external to the core path to graduation.

Further, some classes, for example, biophysics, do not neatly fit themselves into the three specified tracks. As a result, the enrollment in these courses, which otherwise would have attracted broad interest, was artificially depressed. Finally, it was determined that this track system did not provide sufficient flexibility to allow students to build a path through the major that best suited them and their goals.

Since the new system just started in Fall 2019, we plan on assessment activities throughout the next academic year.

Section 3: Actions Taken Based on Assessment Analysis

As described above, the primary response to this analysis has been a re-evaluation (and subsequent abolishment) of our track system. During 2019 the PHYS Curriculum committee made significant changes to the major in response to these findings. At this time, the 'tracks system' has been replaced with a set of suggested paths through the major. These new flightpaths include: “graduate school”, “physics education”, and “industrial research”. These paths will offer an outline for a student’s physics career that can be modified in consultation with the undergraduate advisor to provide a tailored education for each physics major.

Section 4: Other Efforts to Improve the Student Educational Experience

The department has been continually revising and improving our efforts to teach science literacy to non-majors, in concert with the Science Literacy Program, focusing on evidence-based practices that promote assessment, inclusion, and active learning. In addition, the department has been revising and updating the laboratory courses and beginning to put together a data science path through the major. In 2019 many of our classes at all levels in the major have incorporated vetting active learning into their curricula. Exemplary examples of this are in our senior-level Electricity $ magnetism classes (PHYS 412, 413, 422) as well as in our General Education classes like ASTR 122 and PHYS 153.

In 2019 we also started piloting a new class for some of our 2nd year majors. This is the inclusion of a 1-credit “PHYS/MATH Boot Camp” in Spring term. This class will be strongly recommended for PHYS majors that are exhibiting a need for remedial mathematics and/or physics conceptual learning. It is being taught by one of our most proactive faculty in the realm of active learning.

Section 5: Plans for Next Year

In the 2020 academic year the Physics curriculum committee will continue assess the functionality of the core introductory curriculum presented in the Physics 25X and 35X sequences. The goal of this assessment will be a potential reorganization of the curriculum in order to bring students more rapidly to the point at which they can begin to take the courses described above as central to the Physics major. One significant consideration is to potentially delay the start of the “PHYS 250s” till Winter term of each year. This will give PHYS majors that need a term of remedial MATH a term to get prepared for this initial sequence in the major. Through analysis of retention data, the department has recognized that this “first term barrier” seems to be a significant place we lose majors, we hope that the delay of the sequence will help plug this leak in the pipeline.

A secondary goal will be to continue to reorganize the curriculum to make more aggressive use of computational and data sciences approaches, which are rapidly becoming as important to the study of Physics as mathematical knowledge. In 2019 we reached out to our colleagues in the CIS and MATH department about how to continue making some of our ‘overlapping’ classes more interdisciplinary in nature.