Form E-1-A for Boston College Core Curriculum

Department/Program __PHYSICS_____ **May 2022**

1) **Have formal learning outcomes for the department's Core courses been developed? What are they?** (What specific sets of skills and knowledge does the department expect students completing its Core courses to have acquired?)

   The Department of Physics Core courses share with the university's Natural Science Core the same desired outcomes, namely that at the completion of a Core course students will have:

   a) expanded their understanding of the principles, body of knowledge, and investigative strategies that comprise physics and its technological applications;
   b) developed a scientific literacy that will promote curiosity, respect for the scientific method, and general awareness of the limitations of scientific conclusions;
   c) recognized the role of scientific discovery, past, present, and future, in interrelated concerns such as human health, societal well-being, and planetary sustainability; and
   d) appreciated the role of physics in defining their relationship with the natural world and their position within the cosmos.

   These outcomes are accomplished through presentation of fundamental principles in classical and/or quantum principles, including logical and mathematical analysis techniques (at a level appropriate for the course) and historical background into the investigations that led to the development of those principles. All courses include connections of physics principles and current physics research to the development of solutions to problems in healthcare, protecting the environment, and overall societal well-being.

2) **Where are these learning outcomes published? Be specific.** (Where are the department's expected learning outcomes for its Core courses accessible: on the web, in the catalog, or in your department handouts?)

   The complete list of outcomes is published on the Department of Physics "Undergraduate Program" www.bc.edu/content/bc-web/schools/mcas/departments/physics/undergraduate.html

3) **Other than GPA, what data/evidence is used to determine whether students have achieved the stated outcomes for the Core requirement?** (What evidence and analytical approaches do you use to assess which of the student learning outcomes have been achieved more or less well?)

   The data differ depending on the nature of the Core course with respect to amount of rigor and mathematical detail. Student evaluations are reviewed for all Core courses. In the problem-solving based Core courses that cover classical mechanics (PHYS1500, PHYS2100, and PHYS2200), the department administers "Force Concept Inventory"/Mechanics Baseline test at the beginning and end of the semester to assess student learning over the semester.

4) **Who interprets the evidence? What is the process?** (Who in the department is responsible for interpreting the data and making recommendations for curriculum or assignment changes if appropriate? When does this occur?)

All physics faculty members who teach Core courses participate in interpreting the evidence, for example, by administering and analyzing results from the Force Concept Inventory exams. However, it is the responsibility of the Undergraduate Affairs Committee (UAC) with the department Chairperson to coordinate the process, evaluating and analyzing departmental data. That committee reports to the physics faculty as a whole and receives their input. Based on this, and in cooperation with the department's Teaching Committee and Chairperson as needed, the UAC will (a) work with instructors to develop specific ways to better meet program goals and address deficiencies and (b) make recommendations to the Chairperson and/or faculty for changes in the curriculum.

5) **What were the assessment results and what changes have been made as a result of using this data/evidence?** (What were the major assessment findings? Have there been any recent changes to your curriculum or program? How did the assessment data contribute to those changes?)

The Department of Physics offers four Core two-course sequences. Three are traditional problem-solving courses: **PHYS1500-1** (3 credits) is algebra-based and for non-science majors, and includes non-science major students in the Pre-Health Program. The other two are calculus-based. **PHYS2200-1** (4 credits) is a course sequence for physical science, computer science, engineering and math majors with a fall enrollment in 2 sections of roughly 50 students each, and **PHYS2100-1** (4 credits) is larger course sequence for Biology majors and students in the Pre-Health Program (two sections typically with total enrollment over 200 students). This sequence is also offered during the summer. The three of them comprise the basic areas of physics at the introductory level, but differ in focus, the level of rigor (as reflected in credit hours), and mathematical detail.

We introduced the summer course *The Art of Physics* (**PHYS1400**) into our fall 2021 curriculum. The course takes an integrated approach to the philosophy, history, and quantitative reasoning of physics.

Structure of the Universe I&II **PHYS1100-1** is a two-semester course sequence for students interested in the non-technical aspects of astronomy and cosmology

<u>Results/changes</u>:

The FCI exam 'normalized g-score' for PHYS2100-1 ('g of the averages') was 0.46. This score is at the high end of the spectrum of net learning outcomes based on large-scale data as expected at Boston College, well above the national average of roughly 0.27. The current instruction formats are adequate, with no major changes planned.

Based on comments from engineering majors in our PHYS2200 sequence, a second section of PHYS2200 specifically oriented to their needs was created. During the fall of 2021 these students were in the same class as our physical science majors.

For PHYS1400, student evaluations were positive and the course is near maximum capacity for the fall of 2022.

For PHYS1100-1, the reviews were mixed, in part due to instructor issues and in part due to a perceived elevated level of mathematical requirements. Both problems were discussed with one instructor (the other instructor retired) and solutions to that problem discussed and we shall see if the issues are resolved.

6) **Date of the most recent program review.** (Your latest comprehensive departmental self-study and external review)

In review: we have submitted a proposal for a new BS degree program in Applied Physics to the BC Educational Policy Committee. As part of our curriculum expansion, which better represents the faculty research interests in applying foundational physics principles to technologies relevant to current society problems, we are discussing the development of core (non-major) applied physics courses e.g. *Quantum Technology and Society*.

External review: December 2009