Program Assessment Plan for Physics & Astronomy – Undergraduate Programs - DRAFT

I. Document Control Plan

This document, the “Program Assessment Plan for Physics & Astronomy – Undergraduate Programs,” will be housed in the Department of Physics and Astronomy and will be controlled by the Undergraduate Programs Assessment Coordinator as assigned by the Department Chair. The document will be updated every five (5) years and approved by the Department Faculty by Reading Day in the Fall Semester based on input from Department Faculty and guided by similar entities (NC Department of Public Instruction [DPI], Appalachian’s Strategic Plan, Southern Association of Colleges & Schools [SACS], etc.). The document will be made available on the department website no later than the first day of classes in the Spring semester of each five-year cycle. The document will be tracked by academic year of applicability, as specified in the footer below. The annual progress report is a separate document available from the Undergraduate Programs Assessment Coordinator or from those with access to TracDat.

2009-10 Undergraduate Programs Assessment Coordinator:

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Boone, NC, 28608

II. Mission and Vision Statements

Mission Statement
The Department of Physics and Astronomy is responsible for the preparation of students for numerous careers requiring a technical background and for offering service courses at appropriate levels for students in many disciplines. In addition, the Department is active in research and in service to the region and to other departments of the University. (1995 edition)
Vision Statement
In concert with the ASU strategic plan, UNC-tomorrow, and our program assessment plans, the Department of Physics and Astronomy’s vision is to further the legacy of excellence in undergraduate teaching, continue the development of graduate programs, and grow scholarship that will position our department faculty and graduates as leaders in their respective fields.

III. Learning Goals & Outcomes - Summary
This section contains the learning Goals and Outcomes for undergraduate programs in Physics & Astronomy. The Goals for Undergraduate Physics are the same for all three programs (266A – Teaching; 269A – BA; 270B – BS, Applied Physics). The Outcomes for all three programs are the same for Goals 1 through 4, with some minor differences in the Outcomes for Goal 5. These differences are indicated below. (Note: Separate documents for each program area are required for various agencies, NCDPI, SACS, etc.)

Learning Goals
1. Students should demonstrate a fundamental understanding of classical and modern physics
   Learning Outcomes
   Student will:
   a. Demonstrate an understanding of Newton’s laws, Maxwell’s equations, and Schrodinger’s equation
   b. Demonstrate the mathematical concepts and methods appropriate for classical and modern physics.
   c. Answer conceptual questions in classical mechanics, electricity & magnetism, and modern physics.
   d. Answer quantitative problems in classical mechanics, electricity & magnetism, and modern physics.

2. Students should demonstrate advanced analytical, critical thinking and problem-solving skills
   Learning Outcomes
   Student will:
   a. Interpret mathematical models such as formulas, graphs, tables, and schematics, and draw inferences from them.
   b. Apply appropriate mathematical concepts and models for solving problems in classical and modern physics.
   c. Estimate and check answers to problems in order to determine reasonableness, identify alternatives, and select optimal results.
3. **Students should demonstrate experimental skills in basic and applied research**

   **Learning Outcomes**
   Student will:
   a. Construct and assemble experimental apparatuses to conduct experiments that decisively test a hypothesis.
   b. Analyze experimental results and draw reasonable conclusions from them.
   c. Interpret experimental data to make meaningful comparisons between experiment and theory.
   d. Identify and assess sources of experimental uncertainty and error.

4. **Students should demonstrate communication skills, especially in scientific/technical settings**

   **Learning Outcomes**
   Student will:
   a. Locate research results by searching electronic and traditional databases.
   b. Effectively select and use hardware, software applications, and other technologies for communication.
   c. Convey physics concepts to a general audience.
   d. Present research in a form consistent with the AIP style manual.

5. **Students should contribute to the field of science and/or engineering at the entry level in industry, government, or academia**

   **Learning Outcomes**
   Student will:
   a. Demonstrate proficiency in standard software tools (Excel, Word, Graphical Analysis, etc.) for modeling, data analysis, and report writing.
   b. Apply their physics experience and knowledge to analyze new situations.
   c. Identify and use standard laboratory equipment and instrumentation.
      i. **Teachers (266A):** Teachers will also be able to set up and use standard laboratory equipment and instrumentation in a high-school setting.
   d. **Teachers (266A):** Develop a variety of teaching strategies to accommodate multiple learning styles of students.
      Or **BA (269A):** Demonstrate understanding of upper-level physics content.
IV. Assessment Plan for Learning Outcomes

A. Evaluation Protocols

Learning Outcomes for the program will be evaluated according to the protocols listed in Table 1. Column headings refer to the following categories:

- **Where measured** – when is outcome/goal assessed: which course(s), at beginning and or end of time in department, etc.
- **Outcome** – how we know student has achieved Learning Outcome. Shortcut names for TracDat Learning Outcome entries are included in brackets [] at end of Outcome statement.
- **Data/Evidence** – what data are collected & how information will be used to evaluate the program
- **How measured** – in what manner will the student be assessed: rubric, standardized tests, etc.
- **Status** – what needs to be done to implement the evaluation process/instrument
- **Reporting period** – how often will assessment information be collected and who is responsible for collecting the information

*Note:* All Data/Evidence are to be in a format that can be electronically entered into TracDat.

**Table 1:** Protocols for assessing program outcomes.

<table>
<thead>
<tr>
<th>Where measured</th>
<th>Outcome(s) [TracDat Outcome name]</th>
<th>Data/Evidence</th>
<th>How measured</th>
<th>Status</th>
<th>Reporting period</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY4210</td>
<td>1.a. Demonstrate an understanding of Newton’s laws, Maxwell’s equations, and Schrodinger’s equation [Fundamental laws &amp; equations] 1.b. Demonstrate the mathematical concepts and methods appropriate for classical and modern physics. [Math methods] 2.a. Interpret mathematical models such as formulas, graphs, tables, and schematics, and draw inferences from them. [Math models] 2.c. Estimate and check answers to problems in order to determine reasonableness, identify alternatives, and select optimal results. [Check answers]</td>
<td>Student scores for talks/posters and reports. <strong>Goal:</strong> Minimum scores “Acceptable” for each class</td>
<td>4210 Talk, Poster, Report Rubrics</td>
<td>In use</td>
<td>Yearly by course instructor(s)</td>
</tr>
<tr>
<td>Course</td>
<td>Goal</td>
<td>Rubrics</td>
<td>Frequency</td>
<td>Responsible Party</td>
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<tr>
<td>PHY2210 &amp; PHY4210</td>
<td>3.a. Construct and assemble experimental apparatuses to conduct experiments that decisively test a hypothesis. [Construct approaches]</td>
<td>Student scores for talks/posters and reports. <strong>Goal:</strong> Minimum scores “Acceptable” for each class</td>
<td>4210 Talk, Poster, Report Rubrics</td>
<td>In use in 4210. Needed in 2210. Yearly by course instructor(s)</td>
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<td></td>
<td>3.b. Analyze experimental results and draw reasonable conclusions from them. [Analyze data]</td>
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<td></td>
<td>3.c. Interpret experimental data to make meaningful comparisons between experiment and theory. [Interpret data]</td>
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<td></td>
<td>3.d. Identify and assess sources of experimental uncertainty and error. [Uncertainty]</td>
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<td>4.a. Demonstrate proficiency in standard software tools (Excel, Word, Graphical Analysis, etc.) for modeling, data analysis, and report writing. [Use software]</td>
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<td>4.b. Effectively select and use hardware, software applications, and other technologies for communication. [Use technology]</td>
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<td>5.a. Apply their physics experience and knowledge to analyze new situations. [Apply physics]</td>
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<td>5.b. Identify and use standard laboratory equipment and instrumentation. [Use equipment]</td>
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<td><strong>Teachers (266A):</strong></td>
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<td>5.c. (cont’d) (for 266A only) Teachers will also be able to set up and use standard laboratory equipment and instrumentation in a high-school setting. [Use equipment]</td>
<td>Student scores for in-class presentations that use equipment</td>
<td>RCOE rubrics</td>
<td>In use</td>
<td>Every 1 to 2 years by Teacher Education Coordinator</td>
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<tr>
<td>Diagnostic Tool</td>
<td>1.c. Answer conceptual questions in classical mechanics, electricity &amp; magnetism, and modern physics. [Conceptual understanding]</td>
<td>Pre-test scores from 1st intro course and Post-test scores from end of 4210</td>
<td>Pre- and post-test comparisons</td>
<td>In use</td>
<td>Dept Assessment Committee</td>
</tr>
<tr>
<td>PHY3400: Physics Instruction Practicum and Student Teaching</td>
<td>5.d. <strong>Teachers (266A):</strong> Develop a variety of teaching strategies to accommodate multiple learning styles of students. [Teaching strategies]</td>
<td>Student scores for in-class presentations and student teaching</td>
<td>RCOE Rubrics</td>
<td>In use</td>
<td>Every 1 to 2 years by Teacher Education Coordinator</td>
</tr>
<tr>
<td>Course</td>
<td>Outcomes</td>
<td>Assessment Plan</td>
<td>Yearly by</td>
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<tr>
<td>PHY 2210</td>
<td>4.a. Locate research results by searching electronic and traditional databases. [Research databases]</td>
<td>Student scores on research assignment Rubric To be developed</td>
<td>course instructor(s)</td>
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</tbody>
</table>

B. Program Annual Progress Report
Each year, a progress report summarizing the results from the Program Outcomes will be presented to the department. Data/Evidence from the Outcomes entered into TracDat will be collected by the Assessment Coordinator, or designated representative, and summarized for the progress report. Members of the Assessment and Curriculum committees will work in concert to generate the full report and to provide recommendations to the department for the program(s). The annual progress report will be housed in the Department of Physics & Astronomy in the office of the Department Chair. Copies of the report will be made available upon request.