Assessment Plan in Department of Physics at Montana State University
May 15, 2017

Department Mission Statement

The Department of Physics is committed to providing the highest quality physics education to students in the campus environment. Meeting this goal requires successful, nationally competitive, research programs that contribute to the body of physics knowledge, improve science communication with the public, and forge links between fundamental knowledge and applied technology for the benefit of the people in the state of Montana.

B.S. Degree in Physics - Program Objectives

The objectives of the three degree options and the minor in Physics have the same fundamental curricular building blocks. The students in all options follow the same core curriculum up to the level that meets their degree objectives. Thus, a single assessment plan is used for all three options.

Professional Option: To provide students with a sound background in the fundamentals of physics and mathematics and with the knowledge and problem-solving and analytical skills necessary to succeed as graduate students in physics or other technically oriented field or to succeed in the technical workplace.

Interdisciplinary Option: To provide students with a sound background in the fundamentals of physics and mathematics and with the knowledge and problem-solving and analytical skills necessary to succeed in an interdisciplinary technical workplace.

Physics Teaching Option: To provide students with a sound background in the fundamentals of physics and mathematics and with the knowledge and teaching skills necessary to succeed as a secondary school teacher.

Physics Minor (Non-Teaching): To provide students with a sound background in the fundamentals of physics and to enhance their knowledge and problem-solving and analytics skills.

Learning Outcomes:

1. Discipline-Specific Knowledge: Graduates are expected to have in-depth knowledge in the following areas of fundamental physics: classical mechanics (including Newtonian, Lagrangian, and Hamiltonian approaches); electromagnetism (including statics, dynamics, and circuits); Quantum mechanics (including bound state problems, potential scattering, angular momentum, and perturbative methods); waves and oscillations.

2. Breadth of knowledge: Graduates are also expected to have knowledge at the introductory level in the additional (elective) topics of physical and geometrical optics, laser physics, thermodynamics and statistical physics, astronomy, solid-state physics, special relativity, atomic physics, astrophysics, nuclear physics, and particle physics.

3. Communication skills: Graduates are expected to have the ability to present the results of their work in oral and written form, as well as the ability to communicate with members of scientific teams, supervisors, and clients.

4. Problem-solving skills: Students are expected to be able to formulate and solve problems analytically and numerically. Their mathematical skills are expected to include working knowledge of calculus (including vector calculus), ordinary and partial differential equations, and linear algebra, as well as advance mathematics skills obtained from math elective coursework.

5. Experimental design skills: Students will complete Capstone projects that integrate their physics knowledge and problem-solving skills, including basic electronics, data acquisition, data analysis, and experimental design as appropriate to the research topic.

6. Option-specific outcome: Graduates are expected to have additional knowledge and skills as appropriate to their selected option: Professional Option - additional elective Physics courses; Interdisciplinary Option - additional courses in selected discipline; Teaching Option – additional EDSI courses in education department.

Types of Student Data (Indicators) Collected:

Discipline-Specific Knowledge: Learning assessment in courses takes place through examinations and assignments that are part of the coursework in each subject area. In the physics community, there is a consensus on key concepts in core physics areas, and these exams and assignments conform to these norms. These assessments are the responsibility of the instructors of the courses who grade the exams and assignments.

Communication Skills: Assessment of communication skills is an on-going process during coursework in physics. Students are expected to submit written work in each course and to participate actively in classroom discussions and presentations. Laboratory courses require increasingly complex written reports. These assessments are the responsibility of the instructors of the courses who grade projects using the above rubrics.

Problem-Solving Skills: Assessment of analytical skills takes place continually through assignment and grading of homework sets and examinations in all physics and mathematics courses. These assessments are the responsibility of the instructors of the courses.

Research and Experimental laboratory skills: Assessment of research and laboratory skills is through observation of lab procedures and the submission of written laboratory reports. These assessments are the responsibility of the instructors of the courses. When appropriate, additional faculty will help critique laboratory projects. Students will complete senior projects that integrate their physics knowledge and problem solving skills. Their research skills will be continually assessed by their research advisors.

For each course from which student performance data are collected, the instructor will provide at least two examples (mid-term and final) of typical student work earning a

score in the top, middle, and lower third of the class using the rubrics provided here. In addition, the instructor will provide the complete list of scores from that class for the corresponding assignments that have been collected. The latter will be used to determine whether the response thresholds have been met for that course.

Scoring Rubrics:

Exceptional (4) – The work is fully correct and complete, with correct responses and proper application of concepts to solve problems correctly with only minor mistakes; indicates originality of thinking.

Exceeds expectations (3) – The work is typically correct and complete, with only occasional errors in responses and applications of concepts to solve problems.

Acceptable (2) – The work contains incorrect responses less than half the time and problem solutions are often missing important steps, or are incomplete.

Below expectations (1) – Responses to questions are frequently incorrect and problem solutions show little progress toward completion or are regularly incorrect.

Unacceptable (0) – Responses to questions are missing or not attempted. Exam or homework problems are regularly not started or not submitted.

Response Thresholds:

On average, students will perform at an acceptable or higher level on all indicators

Annual Assessment Process:

1. Data collected from identified courses. Instructors provide data to department office.

2. Collected data are tabulated by members of the Undergraduate Curriculum Committee. Areas where acceptable performance threshold has not been met are identified.

3. Results are presented to the full Undergraduate Committee for their consideration, and a recommendation is developed for presentation to the full faculty.

4. If an acceptable performance threshold has not been met, a faculty response is required: Possible responses:

- Gather additional data next year to verify or refute the results.
- Change something in the course to try to fix the problem.
- Change the acceptable performance threshold.
- Choose a different assignment to assess the outcome.

5. If an acceptable performance threshold has been met, the faculty may still respond to assessment results. It is OK to determine that no changes are needed when students are demonstrating proficiency with each learning outcome. It is also OK to reconsider the expected outcomes and associated sources and types of data collected.

6. A summary of the year's assessment activities and faculty decisions is reported to the Provost's Office in the Department's Annual Assessment Activities report, prepared by the Undergraduate Curriculum Committee, working with the Department Head.

Curriculum Map: Where assessment data will be collected

			Outcomes					
Number	**Course Title**	**Credits**	1	2	3	4	5	6
224	Thermo/Modern Phys III	4	x					
261	Lab Electronics I	2			x		x	
262	Lab Electronics II	2			x		x	
301	Intro Theoretical Phys	3	x			x		
305	Holography	3		x			x	x
320	Classical Mechanics	4	x					
331	Computational Phys	1				x		
343	Modern Physics	3	x					
371	Solar Astronomy	4		x				x
373	Stars/Galaxy/Universe	4		x				x
423	Elect & Magnetism I	3	x					
425	Elect & Magnetism II	3	x					
427	Advanced Optics	3		x				x
435	Astrophysics	3		x				x
437	Laser Applications	3		x				x
441	Solid State Phys	3		x				x
444	Advanced Lab	4			x		x	
446	Thermo/Statis Phys	3		x				x
451	Particle Physics	3		x				x
461	Quant Mech I	3	x					
462	Quant Mech II	3	x					
490	UG Research	1-3			x		x	
499	Sen Cap Pres	1			x		x	

Assessment Schedules

	Year					
Outcome	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
1		x			x	
2			x			x
3	x			x		
4			x			x
5	x			x		
6		x			x	