Physics Ph.D. Assessment Plan

Designation	Title	1.1 Deep knowledge of Physics	1.2 Extensive knowledge of Specialty	2.1 Perform effective research	3.1 Communicate in writing.	3.2 Communicate in multiple ways
PHYS 683	Mathematical Physics II	2	2			
PHYS 721	Electrodynamics I	3				
PHYS 723	Electrodynamics II	3				
PHYS 733	Experimental Particle Physics	1	3			
PHYS 739	Condensed Matter Physics I	2	2			
PHYS 743	Statistical Mechanics	3				
PHYS 749	Condensed Matter Physics II	1	3			
PHYS 751	Theoretical Mechanics	3				
PHYS 761	Nuclear & Particle Physics	2	2			
PHYS 763	Advanced Particle Physics	1	3			
PHYS 765	Advanced Nuclear Physics	1	3			
PHYS 771	Quantum Mechanics I	3				
PHYS 773	Quantum Mechanics II	3				
PHYS 775	General Relativity	1	3			
PHYS 779	Group Theory	1	3			
PHYS 783	Quantum Field Theory	1	3			
PHYS 784	Advanced Quantum Field Theory	1	3			
PHYS 785	Astrophysics & Cosmology	1	3			
PHYS 790	Seminar		2	1	2	3
PHYS 898D	Dissertation	1	3	3	3	3

3	High Importance
2	Medium Importance
1	Low Importance
	No Importance

The Table above shows the mapping of the learning outcomes to the curriculum. Ph.D. students must take and pass a set of required courses that, together, provide the primary basis for Outcome

1.1, Deep Knowledge of Physics. Appropriate elective coursework as determined by the student's graduate committee provides the primary basis for Outcome 1.2, Extensive Knowledge of a Specialty Area. Continued enrollment in either graduate program requires the maintenance of at least a 3.00 grade point average. Course instructors are expected to evaluate student abilities in a given course using rubrics based on exams, homework assignments, and projects.

For students in the Ph.D. program, the Qualifying Exam represents the most important assessment of Outcome 1.1, evaluating student learning in a cumulative way once students have completed all of their required coursework. The exam consists of three subjects: Classical Mechanics (including thermodynamics and statistical mechanics), Electrodynamics, and Quantum Mechanics. Exam questions are submitted by faculty members at SDSM&T as well as USD, our partner institution in the Ph.D. program, ensuring a broad range of questions that thoroughly test student competency in the three subject areas. Students are allowed one "free try" at the exam upon entering the program (prior to any graduate coursework) and subsequently have two attempts at passing, generally beginning after their second year in the program (once all required coursework is completed). This exam evaluates how well students have learned and retained the material covered in the required coursework.

Objective 3 is achieved primarily through a combination of the Seminar Course (taken as many as three times by each Ph.D. student) and individual work with the student's major advisor as part of the student's research. In the seminar course, a set of rubrics will be used to assess these learning outcomes.

Continued assessment of Outcome 1.2 beyond course performance, and assessment of Outcome 2.1, the ability to Perform Effective Research, is the responsibility of the Ph.D. student's graduate committee. A student who has completed the qualifying exam must complete a comprehensive oral exam for admission to candidacy in the Ph.D. program. This oral exam generally consists of a presentation of a research proposal, which is open to the public, followed by an in-depth question-and-answer session with the committee. During this time committee members are free to question students on their proposed research, as well as on general physics matters, particularly if there are concerns about student competency in any particular subjects/areas.

Finally, the last layer of student assessment for Ph.D. students comes in the form of their Dissertation Defense. As with the comprehensive exam, a public defense of the research completed for the student's dissertation is followed by a closed-door session with the student's graduate committee. This closed-door session represents a final opportunity for the committee members to both assess student performance and skill, as well as to raise any concerns that the student has not progressed sufficiently to warrant being awarded their degree.

Exit interviews of graduating students, tracking of job placement, and alumni surveys will provide additional assessment. In all courses, student opinion surveys (IDEA) and formative assessment measures such as open-ended questions and in-class discussions, analogy prompts, and muddiest-point feedback will be employed to assist faculty in continuous improvement of the curriculum.

PHYSICS Ph.D. OBJECTIVES & OUTCOMES

OBJECTIVE 1: Students will have deep understanding of physics.

Outcomes

1. Physics Ph.D.'s should have deep knowledge of the theories that form the basis of classical mechanics, electromagnetism, quantum mechanics, and statistical mechanics.

2. Physics Ph.D.'s should have extensive knowledge of one or more specialized fields such as condensed matter physics, nuclear physics or particle physics.

OBJECTIVE 2: Students will be able to perform effective research in physics.

Outcomes

1a. Physics Ph.D.'s in experimental subfields should be able to design and conduct original experiments in order to investigate physical phenomena. They should be able to analyze data and publish these results in scientific journals.

1b. Physics Ph.D.'s in theoretical subfields should be able to apply, extend, or construct theories in order to describe, explain, or predict physical phenomena. They should be able to describe and publish their work in scientific journals.

2. Physics Ph.D.'s should be prepared to follow a career path towards quality positions in academia or assume leading technical roles in a variety of industries.

OBJECTIVE 3: Students will communicate effectively.

Outcomes

1. Students will communicate in writing about scientific and technical concepts concisely and completely.

2. Students will organize and communicate ideas using words, mathematical equations, tables, graphs, pictures, animations, diagrams, and other visualization tools.