Physics (PhD)

The Department of Physics offers a doctor of philosophy (PhD) degree with a variety of opportunities for research. Current research areas include astronomy and astrophysics, biophysics, condensed matter physics, elementary particle physics, and optical physics.

Several centers and institutes are supported by the Office of the Vice President for Research and Innovation (http://research.uoregon.edu/): the Institute for Fundamental Science (http://ifs.uoregon.edu), the Materials Science Institute (http://materialscience.uoregon.edu), and the Oregon Center for Optical, Molecular and Quantum Science (http://omq.uoregon.edu). These interdisciplinary institutes maintain a close relationship with the Department of Physics (https://physics.uoregon.edu/) as well as related departments.

The doctor of philosophy degree (PhD) in physics is based primarily on demonstrated knowledge of physics and doctoral dissertation research. PhD students also must take and pass the core graduate sequences, listed below, achieving a B– or better grade in each course. Courses may be retaken once to achieve this minimum grade. The director of graduate studies can selectively waive these requirements in exceptional cases:

Core Course Sequence:

Code	Title	Credits
PHYS 611–612	Theoretical Mechanics	6
PHYS 613–614	Statistical Physics	6
PHYS 610	Experimental Course: [Topic] (Math Methods)	4
PHYS 622–623	Electromagnetic Theory	8
PHYS 631–633	Quantum Mechanics	12
Total Credits		**36**

Breadth/Specialized Course Requirements:

Six 4-credit breadth or specialized courses.

In parallel, students must locate an advisor and an advisory committee, who then administer a comprehensive oral examination testing whether the student is ready to undertake dissertation research. The heart of the PhD requirements is research leading to a doctoral dissertation.

Detailed information is available in the Graduate Student Handbook on the department's website (http://physics.uoregon.edu/grad_studies/).

Program Learning Outcomes

Upon successful completion of this program, students will be able to:

- Demonstrate mastery of subject content knowledge. Students should gain a deep and broad understanding of physics. This involves a grasp of core concepts beyond the level typically seen in undergraduate training, as well as familiarity with the aims and methods of various subfields of physics. This understanding is typically achieved through combination of coursework and seminars, colloquia, and meetings.
- Conduct independent research and analysis in their disciple and contribute original and substantive work in their field. This is the primary goal of any doctoral program. Its achievement is demonstrated primarily by the writing of doctoral dissertation and the presentation of an oral dissertation defense, both of which are assessed by a faculty committee.
- Acquire familiarity with the current literature. To contribute original scientific work, a student must be knowledgeable about the present state of his or her field. This familiarity is typically attained through reading, attending seminars, participating in journal clubs, and other such activities.
- Be able to communicate scientific results. The ability to communicate scientific findings, in writing or in presentations, is an important component of a researcher's portfolio. Norms vary considerably between subfields of Physics, prohibiting blanket statements. Considering publications, for example, few author papers with a doctoral student as the lead author are standard in some subfields. In others, scientific papers can have many hundreds of authors. Similar variety exists for presentations. Nonetheless the development of communication skills is a learning objective for doctoral students in Physics.

There are as many paths to a Ph.D. as there are Ph.D. students. Unlike an undergraduate degree, or even a Master's degree, which can typically be completed through a standard program of coursework, a Ph.D. necessarily involves a unique, new contribution to human knowledge. Especially in a field like Physics, there is an enormous diversity of methods and procedures across sub-fields. Therefore, it is futile and unproductive to attempt to describe specific, universal learning goals beyond the broad goal of understanding Physics stated above.

We provide here examples of finer scale learning goals that can apply to some PhD students, stressing that it is not, nor can it be, a set that spans all students, dissertations, and degrees.

Proficiency in data analysis. Nearly all subfields of physics involved quantitative analysis of data. Exceptions include some purely theoretical studies, for example aiming for the invention of analytic mathematical treatments of physical problems. Where relevant, and objective of our Ph.D. program is facility with mathematical methods for data analysis, as well as presentation methods.

Proficiency in experimental design. Many studies in physics involve the design and execution of experiments. Where relevant, and objective of our Ph.D. program is the ability to design experiments, considering relevant issues of resolution, sample size, sources of noise, laboratory safety, etc. It should be noted that the scale of design varies enormously between subfields. In parts of high energy physics for example, studies involve thousands of researchers, with large-scale experimental design conducted by many individuals often years before a particular doctoral student's tenure. In other subfields, experiments are designed by a few researchers, including the doctoral student.

Physics Major Requirements

The doctor of philosophy degree (PhD) in physics is based primarily on demonstrated knowledge of physics and doctoral dissertation research. PhD students also must take and pass the core graduate sequences, listed below, achieving a B– or better grade in each course. Courses may be retaken once to achieve this minimum grade. The director of graduate studies can selectively waive these requirements in exceptional cases:

Code	Title	Credits
Core Coursework Requirements		
PHYS 610	Experimental Course: [Topic] (Mathematical Methods)	4
PHYS 611	Theoretical Mechanics	4

PHYS 613 & PHYS 614	Statistical Physics and Statistical Physics	8
PHYS 622 & PHYS 623	Electromagnetic Theory and Electromagnetic Theory	8
PHYS 631 & PHYS 632 & PHYS 633	Quantum Mechanics and Quantum Mechanics and Quantum Mechanics	12
Specialized Coursework Requirements		**28**
Seven additional courses [1]		
Dissertation Courses		**18**
PHYS 603	Dissertation	
Research Courses		**3**
PHYS 601	Research: [Topic] (at least 3 terms)	
Total Credits		**85**

[1] Normally these courses will be additional courses in physics, but they may include other graduate science or mathematics courses with the prior approval of the Director of Graduate Studies. These courses must be graded and a grade of B or better must be obtained. It is recommended that students complete their specialized courses by the end of their third year.

Next, students must locate an advisor and an advisory committee, who then administer a comprehensive oral examination testing whether the student is ready to undertake dissertation research. The heart of the PhD requirements is research leading to a doctoral dissertation.

Detailed information is available in the *Graduate Student Handbook* on the department's website.