

Ph.D. program requirements

GRADUATE STUDY FOR A Ph.D. IN PHYSICS (Revised September, 2014)

Requirements for advanced degrees are established by the University, the Graduate School, and the Physics Department. Broadly viewed, the Departmental requirements for the Ph.D. are satisfactory completion of minimum course requirements, advancement to candidacy, and completion of a thesis. The student's adviser should be consulted if there are questions or problems.

(a) Ph.D. Minimum Course Requirements

All candidates for the Ph.D. degree are required to take the following courses:

Ph 562	Mathematical Methods
Ph 651, 652, 653	Quantum Mechanics
Ph 654	Advanced Quantum Theory
Ph 621, 641, 642	Dynamics/Statistical Thermophysics
Ph 631, 632, 633	Electromagnetic Theory.

The majority of these course requirements are to be completed in the first two years of the graduate student's program, subject to the scheduling of required courses. Exceptions to this rule must have the approval of the head graduate advisor.

All candidates for the Ph.D. degree must take a minimum of 9 credits of advanced courses in their specialty area. A coherent set of courses may be chosen from:

Ph 575	Introduction to Solid State Physics
Ph 585	Introduction to Atomic, Molecular, and Optical Physics
Ph 671/2/3/4	Condensed Matter Physics
Ph 681/2/3/4	Atomic/Molecular/Optical Physics.

For example, the advanced courses may consist of one introductory course (Ph575 or Ph585) and a combination of three modular courses from Ph671/2/3/4 (Condensed Matter Physics) and Ph681/2/3/4 (Optical Physics). When a candidate needs to take advanced specialty courses outside of the physics department, the student and the major professor should select the courses. If these non-physics specialty courses are to satisfy part of the 9-credit specialty course requirement, the course selection must have the approval of the student's Program Committee and the Head Graduate Advisor, and the "breadth course" (see below) should be in Physics.

In addition, all candidates for the Ph.D. degree must take 3 credits of "breadth" courses outside their specialty area. Courses that may be used to satisfy this requirement include the specialty courses listed above and

Ph 564/5/6	Computational Physics
Ph 595	Introduction to Particle and Nuclear Physics.

Required seminars:

- All graduate students are required to register for and attend the Department Seminar (Colloquium, Ph607-1) each term.
- All graduate students are required to take the Seminar on Professional Communications for Physicists for one term (Ph 607-4 in Spring term).
- First-year students are required to take the Research Seminar for one term (Ph 607-4 in Winter term).
- Graduate Teaching Assistants are required to take the TA Seminar (Ph 607-3) during Fall Term of their first year of study.

Minimum credit requirement for graduate assistants:

Graduate students with full-time assistantships (teaching or research) are required by the Graduate School to take not fewer than twelve nor more than fifteen credit hours per quarter. These credits need not all be in graduate level courses (500 and 600 level).

Example Program

Below is an example program that satisfies the departmental course requirements over seven quarters within these limits. Many variations are possible, and are sometimes necessitated by the offering schedules of required courses.

	Fall	Winter	Spring
1st year	Ph 562 (3) Ph 631 (3) Ph 651 (3) Ph 607-1 (1) Colloquium Ph 607-3 (1) TA seminar *Spec. Sem. (1)	Ph 621 (3) Ph 632 (3) Ph 652 (3) Ph 607-1 (1) Colloquium Ph 607-4 (1) Research seminar Research (1)	Ph 641 (3) Ph 653 (3) Ph 585 or 575 (3) Ph 607-1 (1) Colloquium Research (2)
2nd year	Ph 642 (3) Ph 671 or 681 (2) Ph 607-1 (1) *Spec. Sem. (1) Research (5)	Ph 654 (3) Ph 672 or 682 (2) Ph 607-1 (1) *Spec. Sem. (1) Research (5)	Ph 633 (3) Breadth (3) Ph 607-1 (1) Ph 607-4 (1) Comm. Seminar Research (4)
3rd year	Ph 673 or 683 (2) Ph 607-1 (1) *Spec. Sem. (1) Research or Thesis (8)	Ph 674 or 684 (2) Ph 607-1 (1) * Spec. Sem. (1) Research or Thesis (8)	

*Specialized research seminars such as the Solid State and Optical Seminar (Ph 607-301)

Once the course requirements have been satisfied, the program consists of a 12-credit combination of elective courses, seminars, and research or thesis depending on the student's research interests and guidance from his or her major professor and committee.

An ideal schedule would allow a student to complete his or her course requirements and pass the comprehensive examination by the beginning of the third year. Students are encouraged to begin exploring research opportunities during the first year of study and to engage in research as soon as possible, but in any case during the second year of study.

(b) Advancement to Candidacy

In addition to the course requirements, the student must pass the written comprehensive examination followed by the preliminary oral examination for advancement to candidacy. These exams are described in more detail in a separate document. It is the responsibility of each oral exam chair (usually the student's program adviser) to describe the exam, and its possible outcomes, in detail to each examinee.

(c) Completion of a Thesis

During the first year of study, the student should make an effort to become informed about the fields of specialization offered in the department. These fields include experimental, theoretical, and computational studies in the areas of Atomic/Molecular/Optical Physics, Condensed Matter Physics, and Physics Education Research. The seminar, "Introduction to Research" offered each Winter Term begins this process. Other opportunities include specialty courses in various fields, visits to laboratories where work is in progress, specialized seminars, and the department colloquia at which a wide range of topics is discussed. Journals are available online via any campus internet connection and journals in some specialties are available for the student's perusal in the department reading room.

As early as possible the student should select a program adviser who specializes in the field which appears to be of greatest interest to the student. This program adviser may be one of the faculty with whom the student has become acquainted through contact in classes, seminars, advising, etc. At an appropriate stage, the student will select a thesis project adviser, who may be the program adviser, or another person in the same field of research, or even another person in a different field of research. It is understood that as the student's competence and experience is broadened, he or she may wish to change fields of specialties, and this method provides a mechanism for such a change without prejudice.

Under the direction of the program adviser, the student's program is planned beyond the core curriculum, and a committee is set up to submit formally an approved program to the graduate council. This same committee gives the oral examination for candidacy. Its members may be changed in case of need or desire.

The thesis adviser will assume direction of the student's program, aid in selection of the thesis project, and help the student to obtain financial support for the research project and to establish professional contacts.

There are four steps which are designed to aid the student and major professor in helping the Ph.D. candidate toward the degree:

(1) As early as possible after the choice of program adviser or major professor, a program committee is selected to consider and approve the student's proposed program, and the program is then submitted to the Graduate School. The student must file the program with the Graduate School before the end of the 5th term. This committee normally includes the major professor, another professor knowledgeable in the specialty field, two other physics faculty members, and an outside representative appointed by the graduate school. All except the last are selected by mutual agreement between the major professor and the student. This program-filing is a Graduate School requirement. This full committee also administers the required oral examination for admission to candidacy.

(2) As soon as a thesis problem has been selected, the bibliography mastered, and the first preliminary rough results obtained, the student presents an outline of the scope, background, and purpose of the research to the physics members of the committee. This should constitute a proposal of what is to be done for the thesis research. It is the Committee's responsibility to pass on the suitability of the proposal, so that if it is done as planned, it would comprise an acceptable thesis project. This step is designed to clarify, for all concerned, exactly what is expected. It is not intended to be restrictive; if a new line of interesting work appears in the course of the project, the committee would be expected to be hospitable to a suggestion for a change of plans. Once the initial plan is approved the student is to file a thesis title with the Graduate School. (This title can be changed by petition as often as necessary.)

(3) Every year, the student is to report to the committee on the progress of the thesis research. The student must document the meeting by filling out a form available in the Physics office, which will be placed in the file. The major professor is responsible for placing a signed document in the student's file recording the committee's discussion with the student about the work and the proposed timelines. When the work is in its final stages another meeting of the physics members is to be called and a rough "first draft" considered. It is the committee's responsibility to review this draft in the light of the original (or modified) plan in order to pass on its scientific merit and to suggest any necessary alterations or extensions. The purpose of this meeting is to avoid extensive changes on the student's final draft, and to avoid the disappointment and coercion of the committee members and the student.

(4) After the final thesis is ready, the full committee (including the graduate representative) is called together for the thesis defense and approval of the thesis in final form. Questions about any areas of physics may be asked at this examination at the discretion of the committee.

(5) The departmental thesis requirement shall be considered fulfilled when:

(a) The full committee has approved the thesis (see previous paragraph)

and

(b) A notice of receipt of an article to be considered for publication by a reviewed journal is placed in the student's file. This article is to consist essentially of the major results and analysis of the student's research.

(6) After handing in the thesis the student needs to fulfill all university requirements and hand in two copies of the thesis, in the required format, to the graduate school. The students shall also give the department three copies (one-sided, on special paper). The department will bind these copies, one will be returned to the student, one kept in the departmental archives, and one will be given to the major professor.

(d) Minor Requirements

There is no formal minor requirement for the Ph.D. (Physics major), but every candidate will be expected to have a satisfactory background in mathematics and a broad knowledge of physics beyond the area of the specialty. Preparation in these areas will be subject to examination at (a) the Ph.D. candidacy oral and (b) the thesis defense oral, as well as in the written comprehensives.

A PhD student of non-Physics major must complete at least the M.S. minor requirements. The student must also consult with a minor advisor in Physics to set additional requirements.