

**PROGRAM REQUIREMENTS FOR THE Ph.D. DEGREE IN THE DEPARTMENT OF PHYSICS**  
(Adopted April 2020)

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

For the Ph.D. degree, the Graduate School requires 108 credits with a minimum 3.00 grade point average (GPA) and no grades below C on the program of study. The program must contain at least 36 thesis credits (PH 603) and no more than 15 credits of "blanket" courses (PH 601, PH 605, PH 607).

**(i) Ph.D. Minimum Course Requirements**

All candidates for the Ph.D. degree are required to take the following 9 core courses (27 credits):

PH 562	Mathematical Methods
PH 621	Dynamics
PH 631, 632	Electromagnetic Theory
PH 641, 642	Statistical Thermophysics
PH 651, 652, 653	Quantum Mechanics

These course requirements are to be completed in the first two or three years of the graduate student's program, depending on the advice and approval of the Core-Advising Committee.

The department requires a minimum OSU GPA of 3.00 in the core courses, which will be calculated from the highest 8 grades from the 9 core classes. Retaking a course should be discussed with the Core-Advising Committee. If a student retakes a course, the second attempt will count toward the student's institutional credits (this is OSU's policy for retaking classes).

All candidates for the Ph.D. degree must also take a minimum of 12 credits of advanced courses in order to acquire depth in their specialty area and breadth in one or more other areas. A coherent set of courses may be chosen from courses in the Physics Department or other departments as appropriate. Physics courses include but not limited to

PH 575	Introduction to Solid State Physics
PH 585	Atomic, Molecular, and Optical Physics
PH 591	Biological Physics
PH 555	Astrophysics
PH 581	Physical Optics
PH 582	Optical Electronic Systems
PH 595	Introduction to Particle and Nuclear Physics
PH 633	Electromagnetic Theory
PH 654	Advanced Quantum Theory
PH 671/2/3	Condensed Matter Physics
PH 681/2/3	Atomic/Molecular/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 with approval of the student's Program Committee.

**Required seminars:**

- All graduate students are required to register for and attend the Department Seminar (Colloquium, PH 607-1) 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.

**OSU GPA requirements:**

A minimum grade point average (GPA) of 3.00 is required for all courses taken at OSU as a graduate student and for courses included in the graduate program. Grades on transfer courses will be included in the calculation of the program GPA, but will not affect the GPA of courses taken at OSU. You must meet the minimum GPA requirement before scheduling final oral exams.

**Minimum credit requirement for graduate assistants:**

Graduate students with full-time assistantships (teaching or research) are required by the Graduate School to take no fewer than 12 nor more than 16 credit hours per quarter. These credits need not all be in graduate level courses (500 and 600 level).

**Training in the responsible conduct of research:**

All graduate students are required to take training in the responsible conduct of research (RCR). In our department, RCR training has 3 parts:

- Online CITI training: see the OSU Responsible Conduct of Research Training page: <http://research.oregonstate.edu/ori/responsible-conduct-research>.
- Individual PI training: Principal Investigators will integrate Research Responsibility into their group activities.
- Modules in the Research Seminar (PH 607-4): Module 1, Module 2. The modules can be downloaded from <http://www.physics.oregonstate.edu/research-ethics>.

Graduate students need to complete the CITI training and the modules in their first year as part of the Research Seminar. Completion is documented by printing out the final results page from the CITI training and by attendance at the Research Seminar. Students who missed the research seminar should review the two modules and note that on the CITI printout. The printouts go to Kelly Carter in the Department office.

**Pedagogical training:**

The core-advising committee will meet with students at the beginning of Year 1 to help students identify appropriate pedagogical training. For example, It may be a course or workshop about being an effective teaching assistant in physics. The student must participate in and pass the training.

**Inclusion and diversity training:**

The core-advising committee will meet with students at the beginning of Year 1 to help students identify appropriate inclusion and diversity training. For example, it may be a course or workshop about inclusion and diversity. The student must participate in and pass the training.

**Example Programs**

The 9 core courses are regularly scheduled in an academic year as shown in the table.

**Annual Core Course Schedule**

Fall	Winter	Spring
Ph 562 MathM	Ph 631 E&M I	Ph 632 E&M II
Ph 651 QM I	Ph 652 QM II	Ph 653 QM III
Ph 621 CM	Ph 641 SM I	Ph 642 SM II

Below are example programs that satisfy the departmental course requirements over 6 quarters. Many variations are possible and are sometimes necessitated by the course schedules.

**Example1: EM and QM in 1<sup>st</sup> year**

	Fall	Winter	Spring
<b>1<sup>st</sup> year</b>	PH 562 (3) PH 651 (3) Pedagogy Training (3) PH 607-1 (1) Colloquium PH 607-3 (1) TA seminar PH 607-301 (1) SSO sem	PH 631 (3) PH 652 (3) Elective (3) PH 607-1 (1) Colloquium PH 607-4 (1) Intro Rsrch. PH 601 (1) Research	PH 632 (3) PH 653 (3) PH 575 or 585 (3) PH 607-1 (1) Colloquium PH 601 (2) Research
<b>2<sup>nd</sup> year</b>	PH 621 (3) Elective (3) PH 607-1 (1) Colloquium PH 607-301 (1) SSO sem PH 601 (4) Research	PH 641 (3) Elective (3) PH 607-1 (1) Colloquium PH 607-301 (1) SSO sem PH 601 (4) Research	PH 642 (3) PH 607-1 (1) Colloquium PH 607-4 (1) Comm Sem PH 601 (7) Research

**Example2: EM in 2<sup>nd</sup> year**

	<b>Fall</b>	<b>Winter</b>	<b>Spring</b>
<b>1<sup>st</sup> year</b>	PH 562 (3) PH 651 (3) Pedagogy Training (3) PH 607-1 (1) Colloquium PH 607-3 (1) TA seminar PH 607-301 (1) SSO sem	PH 652 (3) Elective1 (3) Elective2 (3) PH 607-1 (1) Colloquium PH 607-4 (1) Intro Rsrch. PH 601 (1) Research	PH 653 (3) PH 541 (3) PH 575 or 585 (3) PH 607-1 (1) Colloquium PH 601 (2) Research
<b>2<sup>nd</sup> year</b>	PH 621 (3) PH 531 (3) PH 607-1 (1) Colloquium PH 607-301 (1) SSO sem PH 601 (4) Research	PH 631 (3) PH 641 (3) PH 607-1 (1) Colloquium PH 607-301 (1) SSO sem PH 601 (4) Research	PH 632 (3) PH 642 (3) PH 607-1 (1) Colloquium PH 607-4 (1) Comm Sem PH 601 (7) Research

**Example3: QM in 2<sup>nd</sup> year**

	<b>Fall</b>	<b>Winter</b>	<b>Spring</b>
<b>1<sup>st</sup> year</b>	PH 562 (3) PH 531 (3) Pedagogy Training (3) PH 607-1 (1) Colloquium PH 607-3 (1) TA seminar PH 607-301 (1) SSO sem	PH 631 (3) PH 425 or 551 (3) Elective (3) PH 607-1 (1) Colloquium PH 607-4 (1) Intro Rsrch. PH 601 (1) Research	PH 632 (3) PH 541 (3) PH 575 or 585 (3) PH 607-1 (1) Colloquium PH 601 (2) Research
<b>2<sup>nd</sup> year</b>	PH651 (3) PH 621 (3) PH 607-1 (1) Colloquium PH 607-301 (1) SSO sem PH 601 (4) Research	PH 652 (3) PH 641 (3) PH 607-1 (1) Colloquium PH 607-301 (1) SSO sem PH 601 (4) Research	PH 653 (3) PH 642 (3) PH 607-1 (1) Colloquium PH 607-4 (1) Comm Sem PH 601 (4) Research

Once the course requirements have been satisfied, a typical 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 the major professor and the committee.

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.

**(ii) Advancement to Candidacy**

In addition to the course requirements, the student must complete a writing project and pass the preliminary oral examination for advancement to candidacy. The writing project should be completed before scheduling the oral examination. The writing project and the oral examination are described in more detail in a separate document. It is the responsibility of each oral exam chair (usually the student's major professor) to describe the exam, and its possible outcomes, in detail to each examinee.

**(iii) Completion of a Thesis**

The Ph.D. is a research degree and a thesis on the research is required. 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, Biophysics, Physics Education Research, Astrophysics, and High Energy Physics. 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 campus internet connections. It is also possible to do research with professors in other departments. For more information, see the head graduate advisor.

As early as possible the student should select a major professor, who will supervise the research leading to the thesis. Under the direction of the major professor, the student's program is planned beyond the core curriculum and a committee is set up to formally submit an approved program to the Graduate School. This same committee gives the preliminary oral examination for candidacy and evaluates the final oral examination.

There are six steps that are designed to aid progress toward the degree:

- (1) As early as possible after the choice of major professor, a doctoral committee is selected to consider and approve the student's proposed program, and the program is submitted to the Graduate School. The student must file the program with the Graduate School before the end of the 5<sup>th</sup> term. This committee normally includes the major professor, another professor knowledgeable in the specialty field, two other physics faculty members, and an outside representative (GCR: Graduate Council Representative) appointed by the graduate school. All except the last are selected by mutual agreement among the major professor, the student, and the committee member. This committee also administers the required preliminary oral examination for admission to candidacy.
- (2) As soon as a thesis problem has been selected and the first preliminary results obtained, the student presents an outline of the scope, background, and purpose of the research to the program committee at the preliminary oral examination. 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 program committee on the progress of the thesis research. The preliminary oral exam and the final oral exam count as annual meetings. The advisor writes an evaluation of the student, and the student writes a self-evaluation. The evaluations are a list of things the student has done, with emphasis on what was done since the last annual meeting, to make progress towards the learning

outcomes. The committee reviews the evaluation letters before the annual meeting. The student must document the meeting by filling out a scheduling form available in the Physics office, which will be placed in the file. The major professor is responsible for placing the evaluation letters and a signed report document in the student's file recording the committee's discussion with the student about the work and the proposed timelines.

- (4) When the written 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) The student has met the publication requirement approved by the program committee.
- (6) The student shall give the department three paper copies. 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.

**(iv) 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 evaluated in (a) the preliminary and (b) the final oral examinations.

A Ph.D. student in another department who wishes to obtain a minor in Physics must complete at least 18 credit hours of graduate courses. The student must consult with the head graduate advisor in Physics to determine the specific program.