Department of Physics

GRADUATE PROGRAM

HANDBOOK

Drexel University

2012

GRADUATE PROGRAM HANDBOOK

This document describes the doctoral program in the Physics Department and reflects current information, policies, and procedures for Ph.D. students. It supplements the Graduate Studies Office policies which outline the general university requirements and are available at http://www.drexel.edu/provost/graduatestudies/.

Master of Science Program in Physics

The requirement for the master's degree in physics is 45 graduate credits, with at least 30 credits taken in Mathematical Physics (PHYS 501 & PHYS 502), Dynamics I (PHYS 506), Electromagnetic Theory (PHYS 511 & PHYS 512), Quantum Mechanics (PHYS 516, PHYS 517, & PHYS 518), and Statistical Mechanics (PHYS 521 & PHYS 522). The remining 15 credits may include Special Topics courses (see p. 6) and credits for research (optional). There are no thesis, language, or special examination requirements for the master's degree. A minimum 3.0 GPA is required.

Doctoral Degree Requirements

The Doctor of Philosophy degree is conferred in recognition of breadth of scholarship and scientific attainment, plus demonstrated ability to investigate scientific problems independently and efficiently. Doctoral students are required to take a minimum of 45 credits of coursework and research work beyond the master's requirement of 45 credits. A minimum 3.0 GPA is required.

Ph.D. candidates must pass a candidacy examination, written and oral; satisfy a one-year residence requirement; and perform original research, write a satisfactory thesis describing that research, and defend this thesis in an oral examination. The usual schedule for physics graduate students consists of two years of course work, qualifying exams, research training and dissertation research. It is required by the university that a graduate student complete the Ph.D. degree within seven years after enrollment. We expect that most students can complete the Ph.D. in five years.

Physics Department – Ph.D. Timeline

The information in this section is an outline of the program sequence for full-time Ph.D. students entering without a previous Master's degree. Students are expected to follow this sequence in a timely manner to make satisfactory progress.

TERM	FIRST YEAR REQUIREMENTS
Fall	❑ PHYS 501 – Mathematical Physics I ❑ PHYS 506 – Dynamics I ❑ Special Topics
Winter	❑ PHYS 502 – Mathematical Physics II ❑ PHYS 516 – Quantum Mechanics I ❑ Special Topics ❑ Find Research Advisor for Spring quarter research
Spring	❑ PHYS 521 – Statistical Mechanics I ❑ PHYS 517 – Quantum Mechanics II ❑ Plan of Study and Supervising Professor Appointment Form D-1 filed by the fourth week of the third quarter of enrollment as a Ph.D. student ❑ Research oral report by last week of quarter
Summer	❑ PHYS 997 Research (1 credit) ❑ Research written report by last week of quarter ❑ Complete Annual Activities Report (deadline June 30) ❑ Pass the written Qualifying Exam given in September (before beginning of second year – First attempt)

TERM	SECOND YEAR REQUIREMENTS
Fall	❑ PHYS 522 – Statistical Mechanics II ❑ PHYS 518 – Quantum Mechanics III ❑ Special Topics
Winter	❑ Pass the written Qualifying Exam given in January, if necessary (Final attempt) ❑ PHYS 511 – Electromagnetic Theory I ❑ Special Topics
Spring	❑ PHYS 512 – Electromagnetic Theory II ❑ PHYS 997 – Research (3 credits) ❑ Apply for MS degree (First week of May) ❑ Pass the oral Qualifying Exam ❑ Reports on Candidacy Examination Forms D-2 and D-2A
Summer	❑ Begin Thesis Research ❑ PHYS 998 (9 credits) ❑ Dissertation Advisory Committee Appointment Form D-3 ❑ Dissertation Proposal Form D-3A ❑ Thesis Advisory Committee meeting ❑ Annual Review of Doctoral Candidates Form D-3B ❑ Annual Activities Report (deadline June 30)

TERM	THIRD YEAR REQUIREMENTS
Fall	❑ PHYS 998 – Dissertation (9 credits) ❑ Schedule Thesis Advisory Committee meeting
Winter	❑ PHYS 998 – Dissertation (9 credits)
Spring	❑ PHYS 998 – Dissertation (9 credits)
Summer	❑ PHYS 998 – Dissertation (9 credits) ❑ Annual Review of Doctoral Candidates Form D-3B ❑ Annual Activities Report (deadline June 30)

TERM	FOURTH YEAR REQUIREMENTS
Fall	❑ PHYS 998 – Dissertation (9 credits) ❑ Thesis Advisory Committee meeting
Winter	❑ PHYS 998 – Dissertation (9 credits)
Spring	❑ PHYS 998 – Dissertation (9 credits)
Summer	❑ PHYS 998 – Dissertation (9 credits) ❑ Annual Review of Doctoral Candidates Form D-3B ❑ Annual Activities Report (deadline June 30)

TERM	FIFTH YEAR REQUIREMENTS
Fall	❑ PHYS 998 – Dissertation (9 credits) ❑ Review Thesis Manual: All doctoral dissertations, in addition to originality and scholarly content, must conform to University format requirements
Winter	❑ PHYS 998 – Dissertation (9 credits)
Spring	❑ PHYS 998 – Dissertation (9 credits)
Summer or Expected Graduation Term	❑ PHYS 998 – Dissertation (9 credits) ❑ Graduating students must submit the Completion Form by the first day of final exams during the term in which his/her complete his/her studies. ❑ Final Oral Defense Committee Appointment and Schedule Form D-4 ❑ Room Reservation for oral defense ❑ Ph.D. dissertation and oral defense ❑ Report of Ph.D. Final Oral Defense Committee Form D-5 ❑ Thesis Approval: This form must be completed by all students with a thesis requirement and will be included in the bound thesis filed with the library ❑ Provide bound copies of your thesis to the Advisor and the Department of Physics.

Required Coursework

The Physics Department requires that a student complete required courses. The Plan of Study Form D-1 should be filed with the Office of Graduate Studies by the fourth week of the third quarter of enrollment as a Ph.D. student. During the first year of employment as a Teaching Assistant, and as a university requirement, students must also take EDUC 531 and EDUC 775 (Tutorials in College Teaching). Note carefully that students must maintain at least a 3.0 (B) grade point average and that only grades of C and above count for graduate credit.

YEAR	FALL	WINTER	SPRING
First Year	PHYS 501 – Mathematical Physics I PHYS 506 – Dynamics I Special Topics	PHYS 502 – Mathematical Physics II PHYS 516 – Quantum Mechanics I Special Topics	PHYS 521 – Statistical Mechanics I PHYS 517 – Quantum Mechanics II
Second Year	PHYS 522 – Statistical Mechanics II PHYS 518 – Quantum Mechanics III Special Topics	PHYS 511 – Electromagnetic Theory I Special Topics	PHYS 512 – Electromagnetic Theory II PHYS 997 – Research

Special Topics Courses

Special topic courses are an introduction to current topics of experimental and theoretical interest. They are offered in alternate years. In addition to the usual rotating menu of topics classes, General Relativity will be offered in the Spring. If you wish to take this in lieu of one of the other topics classes, then you need to plan ahead by not registering for a topics class in Fall or Winter and doing more research during that quarter. You **must** also inform the Director of Graduate Studies that you are doing so. Doctoral candidates who wish to take this or any other topics class should register for fewer credits of PHYS 998. The total number of tuition credits is fixed.

YEAR	FALL	WINTER	SPRING
AY 2012/2013 (even)	PHYS 626 – Solid State Physics PHYS 576 – Nuclear & Particle Physics	PHYS 571 – Nonlinear Dynamics PHYS 553 – Nanoscience	PHYS 750 - General Relativity
AY 2013/2014 (odd)	PHYS 531 – Galactic Dynamics PHYS 561 – Biophysics	PHYS 532 – Cosmology PHYS 562 – Computational Biophysics	**TBA**

Requirements for Post-Masters Ph.D. Students

Students who are admitted for Ph.D. study with "post-masters" status must take 15 credits of graduate coursework with a minimum GPA of 3.0 to become doctoral candidates. Courses are to be chosen in consultation with the Director of Graduate Studies. Post-masters students are expected to pass the written and oral qualifying exams by the end of the Spring quarter of their first year of study. Ordinarily, this means taking the written qualifying exam in September before the start of classes.

To be prepared for the oral exam, post-masters students should begin research as soon as possible.

Requirements for Part-Time Study

Students may be admitted for part-time study toward the M.S. or Ph.D. degree. The schedule of coursework is to be arranged in consultation with the Director of Graduate Studies. Requirements for the degree are the same as for full-time study, but the schedule may be modified as approved by the Director of Graduate Studies.

Registration for Courses Paid by Tuition Remission

For students supported by assistantships (TA or RA), who receive tuition remission, courses taken outside the Department of Physics are allowed only with permission of the Department. Authorization must be obtained in advance from the Department Head or Director of Graduate Studies. Students will be financially responsible for any unapproved tuition credits.

Find a Research Advisor

A student should find a research advisor by the end of the Winter Quarter of the first year and should begin independent research in that faculty member's field of study under his or her supervision. When a student finds a research advisor, he or she must inform the Director of Graduate Studies. The selection of research advisor should be indicated on Form D-1, to be submitted no later than the fourth week of the spring quarter.

Students who have begun independent research with a faculty member are expected to attend the department's colloquium and seminars in their fields of specialization on a regular basis.

Students who would like to switch research and decide to investigate other possibilities are encouraged to talk to other professors about different opportunities. It is the student's responsibility to communicate to his/her research advisor about their intention.

Advising and Mentoring

The Director of Graduate Studies is responsible for advising first year students until they are established with a research advisor, a faculty member who has agreed to supervise a student's research.

Students are encouraged to discuss their courses with their faculty advisor throughout their career.

Written Qualifying Examinations

The qualifying examination covers four general areas at the advanced undergraduate level: classical mechanics, electricity and magnetism, quantum mechanics, and statistical physics. Example exams from previous years are posted on the department web page.

The written qualifying examination is given twice a year, during the week before the fall quarter begins and the first week of classes of the winter term. The exam is typically administered on a Friday from 9:00 a.m. to 4:00 p.m.

Students may attempt the exam no more than two times. Full-time Ph.D. students must take the exam for the first time no later than September of their second year. Post-masters students must take the exam at the beginning of their first year. Students who have not passed the exam by the beginning of spring quarter of their second year will be dismissed.

Oral Qualifying Exam

The oral qualifying exam is based on original research performed by the student. A written report should be submitted to the exam committee and the Director of Graduate Studies at least one week prior to the exam. The time, date, and location of the talk announcement should be distributed by the student by e-mail and by posting a notice on the Department's Main Office one week before the exam. The research report will be comparable to a term research project report and will be limited to 10 to 20 pages including tables, charts, and bibliography. Appendices, including detailed derivations, technical details, data and computer codes, will be available separately upon request. The subject matter will be at the discretion of the student with approval of a supervisor. The report will include three aspects: review of the problem area; formulation and solution of a small problem; suggestions for further research. The oral examination by 5 faculty will follow an open seminar on the research report. This exam will last about one hour and will include material related to the research report and the written exam. The purpose of the oral exam is to clarify material in the written exam and the research report and to insure adequate scientific oral communication skills.

The student will take these exams after successful completion of at least one year of graduate work at Drexel and prior to the end of the Spring quarter of the second year of doctoral study (post-masters in first year). The purposes of the oral qualifying exam are to determine the student's ability to begin thesis-level research; to ascertain his or her understanding of the fundamental concepts and ideas pertinent to the field of endeavor; and to detect any deficiencies of background that may need further attention. The committee must consist of at least five members, at least three of whom must be currently tenured or tenure-track Drexel faculty members. At least two of the committee members must be from outside the student's primary specialization area. At least one of the committee members must be from outside the student's department, preferably from outside the university. The student's academic department must submit a Report of Ph.D. Candidacy Requirements (Form D-2 and Form D-2A) to the Office of Graduate Studies to finalize a doctoral student's candidacy status. Only if it is deemed appropriate by the Director of Graduate Studies may the oral qualifying exam be attempted a second time (which may be no later than the Summer of the second year).

Doctoral Candidacy

A graduate student becomes a doctoral candidate when he/she has passed the qualifying exams (both written and oral), has no courses graded incomplete, and has accumulated at least 45 credits (including all required coursework listed above and with a minimum GPA of 3.0).

All doctoral candidates are entitled to a special tuition discount. Doctoral candidates can register for up to nine (9) credits per quarter and will only be charged for one (1) credit hour.

Once a student passes the candidacy examination, he or she must be continuously enrolled for a minimum of 1 credit for 3 quarters per academic year until all degree requirements are fulfilled, including the filing of an approved dissertation in the library.

Thesis Advisory Committee

The students should have a discussion with their Thesis Advisor about which faculty should be on their thesis advisory committee (Form D-3). Then, the students should ask the faculty if they would be willing to serve on their committee. At the same time or soon after the appointment of the Dissertation Advisory Committee, students should submit a dissertation proposal for approval by their committee (Form D-3A) and also make room reservations for required meetings. Annual Thesis Advisory Committee meetings are required for all doctoral candidates (Form D-3B).

Annual Progress Reports

Students are required to submit the Annual Activities Report Form. To help students maintain satisfactory progress and to encourage advisor-student contact, students are required, every summer quarter, to complete an annual activities report, which includes comments from their research advisor, as well as a proposed time schedule for finishing the degree. The Director of Graduate Studies will review the reports and meet with students and/or their advisors when progress appears slow. Unsatisfactory progress may result in loss of assistantship support.

Register for Physics 998, Doctoral Dissertation

Students should register for PHYS 998 in all quarters after passing the Oral Qualifying Examination. Students are limited to a maximum of 9 dissertation credits per quarter.

Ph.D. Final Oral Defense

This examination constitutes an open defense of the dissertation. However, the Final Exam Committee is always free to raise any questions it may wish. The Committee must be approved by the Associate Vice Provost for Graduate Studies via the Final Oral Defense Committee Appointment and Schedule (Form D-4). This form must be submitted for approval at least one month prior to the defense. The Candidate is reminded that a printed copy of the final dissertation must be distributed to all Committee members and the Director of Graduate Studies at least two weeks before the scheduled exam to allow sufficient time for a thorough review and analysis. The time, date, and location of the oral defense announcement should be distributed by the student by email and by posting a notice on the Department's Main Office one week before the exam.

The Committee must consist of at least five members, three or more of whom must be currently tenured or tenure-track Drexel faculty members. Two members at minimum must be from outside the student's major area and at least one member preferably from outside the student's department.

Results of the defense are reported to the department and Office of Graduate Studies by the Committee Chair via the Form D-5. Signatures of all committee members must appear on the completed Form D-5. This form must be returned to the Office of Graduate Studies by the Committee Chair within 48 hours of the exam. The Committee should also formally approve the dissertation using the Thesis Approval Form; the student is responsible for making sure all signatures are obtained and the original is submitted for binding with the thesis. In the case of a disagreement within the Committee, the Chair should consult with the Associate Vice Provost for Graduate Studies.

Dissertation Format

All doctoral dissertations, in addition to originality and scholarly content, must conform to University format requirements. Students should obtain a copy of the Thesis Manual. The doctoral student and supervising professor are responsible for conforming to the university format requirements.

Ph.D. Students Graduation Checklist

- File an application for degree by the appropriate deadline for the term in which you intend to graduate.
- Submit your Form D-4 to the Graduate Studies Office with your defense date and committee composition one month prior to your final defense.
- Review the Thesis Formatting Manual and start formatting your thesis.
- Take forms with you to your final defense - the Report of the Final Oral Defense Form D-5 and the Thesis Approval Form. Your committee members will need to sign these forms.
- After your final defense, have your department send the Form D-5 to the Graduate Studies Office at 3141 Chestnut Street, Randell Hall 240.
- Fill out the Completion Form and have it signed by the appropriate people.
- Submit the original, copies, and a PDF of your dissertation to Hagerty Library along with fees, along with: your original Thesis Approval Form (signed and approved by all your thesis committee members, advisor, and your department head) to be bound with your thesis; and your Completion Form, to obtain the thesis/dissertation assistant's signature.
- Submit bound copy to the Department office. Submit your signed Completion Form to the Graduate Studies Office (3141 Chestnut Street, Randell 240) for final degree clearance.
- Complete the Survey of Earned Doctorates and return with your Completion Form to Graduate Studies.
- Review the University's Graduation Requirements and ensure you are in full compliance.

Full-time vs. Part-time Student Status

The following information about student status is just a guide; the actual requirements of an outside agency may vary. Please read the Graduate Student Policies.

Based on course enrollment, graduate students are full time when registered for at least 9 credits for any three quarters in an academic year. As noted in the plan of study detailed in this handbook, graduate students in the full time Ph.D. program do not always register for 9 credits in each quarter. Tuition remission for supported students is given during the first two years for the 45 credits necessary to achieve doctoral candidate status (and receive the MS degree). The typical pattern of registration during the Fall, Winter, Spring quarters in the first two years is 9, 9, 6, then 9, 6, 6.

After reaching doctoral candidacy, most Ph.D. students register for 9 credits per quarter in three out of four quarters each year of Dissertation Research.

It is important that students be aware of their status, whether they are considered full time or part time, for many purposes, including U.S. immigration status, student loan deferral, and outside health insurance. It is the responsibility of the student to be aware of the student status requirements of their visa, loan, insurance, etc, and to comply with those requirements.

International students must be full-time students. Please read carefully the instructions in the International Students and Scholar Services website.

For purposes of student loan deferral from most agencies, graduate students must be enrolled for at least half-time (4.5 credits). Students are responsible for checking these requirements.

Students who are carried on family health insurance policies should carefully check on the terms of their coverage, as regards full-time student status. The Graduate Studies Office may provide documentation to support "full time" status in these cases.

UNIVERSITY AND DEPARTMENT POLICIES

Grade Points

Grade points for each credit hour received in a course will be computed as follows:

A+ = 4.0	B+ = 3.33	C+ = 2.33	D+ = 1.33
A = 4.0	B = 3.0	C = 2.0	D = 1.0
A– = 3.67	B– = 2.67	C– = 1.67	F = 0.0

Enrollment Requirement

Full-time quarterly enrollment for graduate students is 9 credits. A student must maintain registration as a full- or part-time student for the quarter the master's degree, or doctoral degree is conferred. The responsibility for being properly registered for courses and maintaining full-time status rests with the student.

Grades

The information in this section reviews important University and Department policies regarding Graduate Study.

It is the student's responsibility to check grades in Banner each quarter to make sure they have been correctly reported. The student should see his/her instructor about grade disputes and missing grades. Incomplete (INC) indicates that some portion of the student's work is lacking, for an acceptable reason, at the time the grades are reported. The students should make sure that "INC" grades are cleared when courses are completed. "INC" grades will be changed to "F" after one year and will be reflected in the student's GPA. A graduate student must maintain a minimum grade point average (GPA) of 3.00.

Repeating Courses

Graduate students may repeat any course. Both the first and second grades will be included in the cumulative GPA. Subsequent grades will not be included, but will appear on the permanent record. The number of credits earned in the course will apply toward degree requirements only once. A grade below C is not accepted for credit toward a graduate degree. Students may only repeat a course in which they received a grade of C–, D+, D, or F.

Language Competence Requirements and Examinations

It is assumed that students from English-speaking countries who are admitted to the Graduate School are competent in the English language. Students from non-English-speaking countries must demonstrate a satisfactory command of English, both for admission and for appointment as Teaching Assistants.

Satisfactory Progress

Admission for graduate study at Drexel allows students to continue graduate study and research in the Department of Physics only as long as they maintain satisfactory performance and progress toward completion of their graduate degree program.

Students whose cumulative or quarterly GPA falls below a 3.0 will be on probation and risk dismissal if they do not raise their GPA above 3.0 within two quarters. Doctoral program students are to be reviewed by the Director of Graduate Studies. In evaluating the student's performance and progress, all of the following will be reviewed:

- Grade reports: cumulative and quarterly GPA's computed on those courses required in the Physics Graduate Program.
- Incomplete grades must be resolved before the end of each academic year.

- Performance during informal course work and seminar.
- Research capability, progress, and performance.
- Any other information relevant to graduate program academic requirements.

A determination of satisfactory performance and progress may be made upon review of the factors indicated above. Students who fail to meet any of the requirements may be placed on probation. If a student is placed on "Probation," a definite timetable for remedying the situation is required and can lead directly to termination from the program.

Community Responsibilities

As members of the Physics community, all students are expected to help out occasionally with special events such as our department open houses, conferences, and colloquia.

FINANCIAL SUPPORT

Continued financial support from an assistantship (TA or RF) requires that a student maintain regular academic status and make adequate progress toward completing their degrees. Students with a Research Assistantship (RA) or Teaching Assistantship (TA) are expected to spend full time on education and assigned duties and may not engage in any other activity for compensation without the specific approval of the Director of Graduate Studies.

Research Fellowships

Research Assistantships support students who are pursuing a graduate degree and devote full attention to their research. They are funded by external sources and the RFs are supervised by the faculty member who has obtained funding for a specific project. The appointments are generally given on a term basis.

Teaching Assistantships

In addition to providing support for graduate students, teaching assistantships help students to enhance their classroom skills. All incoming graduate students are required to participate in the TA orientation program. Foreign students must be cleared by the English Language Center before they can work as TAs. Teaching Assistants work for 20 hours per week teaching classes, grading homework and exams for instructors, and supervising labs. If a student is supported as a TA and starts working towards a non-physics degree, TA support will be terminated.

Funding Opportunities

There are a variety of external funding opportunities available to graduate students and they are encouraged to apply (NSF, NASA, Department of Energy, National Academies, etc). The Drexel Fellowships Office supports students across the University in their applications for competitive national and international fellowships. They raise campus-wide awareness of opportunities and directly help students create strong applications through intensive individual advising and support.

Travel Support

The Office of Graduate Studies offers a limited amount of travel grants to encourage student participation in academic meetings and conferences. The maximum amount awarded will be $200 plus registration fees if applicable (up to an additional $200). Applications are due at least one month before the conference begins.

Who's Who

Prof. Michel Vallières, Department Head, (215)895-2709, vallieres@physics.drexel.edu, Disque Hall, 8th Floor, Room 816. Assigns teaching assistantships.

Prof. Michael Vogeley, Director of Graduate Studies, (215)895-2710, vogeley@drexel.edu, Disque Hall, 8th Floor, Room 811.

Mrs. Laura D'Angelo, Research Coordinator, (215)895-2711, laura@physics.drexel.edu, Disque Hall, 8th Floor, Room 816. She collaborates with the Director of Graduate Studies. Supports graduate students especially with course information and curriculum requirements. She keeps track of the students' academic issues including transcripts, progress reports, and funding information.

Mrs. Janice Wilhelm, Department Administrator, (215)895-6863, wilhelm@drexel.edu, Disque Hall, 8th Floor, Room 816. She oversees the financial accounts in the department and handles HR issues. She is involved with the hiring of graduate students as course teaching assistants (TAs), processes the RA/TA stipends, and temporary student appointments.

Ms. Jacqueline Sampson, Program Coordinator, (215)895-2708, jackie@physics.drexel.edu, Disque Hall, 8th Floor, Room 816. Scheduling of courses.

Mr. Frank Jones, System Administrator, (215)895-1989, sysadmin@physics.drexel.edu, Disque Hall, 9th Floor, Room 908. Setup of computer accounts.