

I. Procedures for Graduate Students in physics

Requirements for the Ph.D. in Physics

These policies are adopted by the faculty of the Department of Physics subject in part to Graduate School and University Senate approval. Dates of adoption not established.

Course Requirements

Core Courses

By the end of the second year of graduate study, the student must pass the following courses with at least a B average: PHY 581 (Introduction to Theoretical Physics), PHY 614 (Graduate Lab), PHY 621 (Classical Mechanics), PHY 641/642 (Electromagnetic Theory), PHY 661/662/763 (Quantum Mechanics), and PHY 731 (Statistical Mechanics I).

Advanced Courses

The student must have his entire program of study approved by a research committee as described in section 3. Approval will be given only if the program includes appropriate advanced courses (typically 12 to 18 credit hours).

Grade Average

An average of at least a B is required for all courses taken.

Examinations

Three examinations are required of a student before awarding of the Ph.D. degree. The three examinations are described below, along with the detailed procedures for the qualifying examination.

Comprehensive Examination

Upon arrival at the Physics Department, a new graduate student is expected to take the Comprehensive Examination, which is offered before the start of the fall semester. The only exception is for those students who immediately take the Qualifying Examination (see above under heading of *Details of Qualifying Examination Procedures*).

The Comprehensive Examination, which is at the level of undergraduate texts such as Halliday and Resnick, or Tipler's *Physics*, covers the areas of mechanics, electricity and magnetism, heat, optics, and modern physics.

The student will be informed of his/her performance, which will also become part of his/her departmental record. This examination involves no formal passing or failing. Its results may, however, be used by the Department in order to distribute teaching assistantships and/or recommend remedial work.

A student may retake the examination in order to improve his/her record.

Qualifying Examination

This important examination, based mainly on the standard first year's graduate course work, is ordinarily taken at the beginning of the student's second year

All students (except those wishing to obtain only a Master's degree via the thesis route) admitted to the graduate program in physics must take the qualifying examination. It is administered only once each year early in the Fall semester. Students are expected to take this examination in the beginning of their second year after matriculation in the physics graduate program. **Students may take the qualifying examination earlier than required; however, they are cautioned to seek their advisors' counsel before making this decision.**

The purpose of the qualifying examination is to determine whether a student has reached a satisfactory level of understanding of four subjects in physics to justify further study towards the Ph.D. degree. The four subjects are: a) classical mechanics, b) electromagnetism, c) quantum mechanics and d) thermodynamics and statistical mechanics. Only topics normally taught in the first year of graduate course work (presently

PHY 621, 641, 661, 662 and 731) and in the prerequisites for these courses will be covered; these topics are briefly described in the appended statement.

Students may petition the physics faculty for exceptions to the rules of the physics department. In particular, a student who fails the qualifying examination may petition the faculty for a second opportunity to take the qualifying examination. It is the policy of the faculty to grant such a petition for extraordinary reasons only. Consult the Graduate Catalog for additional information.

The administration of the qualifying examination proceeds in the following sequence:

Written qualifying examination

This examination will be given at the beginning of the academic year. It will be constructed, administered, and graded by a committee of the faculty appointed by the chairperson. The committee is charged to grade the examination within a week after it is given, and to recommend, to the faculty, which students should be asked to take the supplementary oral examination.

The examination will be based on the material that is generally covered in courses 621, 641, 661, 662 and 731. The necessary mathematical background as taught in 581 is presumed. The following textbooks and topics specify the general level to be expected.

- Classical Mechanics

Texts: Goldstein, Corben and Stehle, Saletan and Cromer.

Lagrangian and Hamiltonian formalisms, canonical transformations, symmetries and conservation laws, rigid body dynamics, normal coordinates and small oscillations.

- Electromagnetism

Texts: Jackson, Eyges.

Electrostatics, magnetostatics, boundary value problems, multipole expansions, dielectrics and magnetic materials, Maxwell's equations and their solutions in free space, advanced and retarded potentials.

- Quantum Mechanics

Texts: Merzbacher; Messiah; Cohen-Tannoudji; Diu and Laloe.

Fundamental postulates of quantum mechanics, Schrodinger equation and its applications to one, two and three dimensional problems. Abstract formalism. Operator approach to physical problems such as simple harmonic oscillator and angular momentum. Symmetry properties. Identical particles. Spin. Time-independent and time-dependent perturbation theory. Potential scattering. Born approximation. Scattering theory. Partial wave analysis. Variational methods.

- Thermodynamics & Statistical Physics

Texts: Reif; Pathria; Reichl; Landau and Lifshitz (Part I); Huang.

Laws of thermodynamics, thermodynamic potentials, thermodynamics of phase transitions, thermodynamic fluctuations and response functions; kinetic theory of gases; Liouville equation; classical ensemble theory: microcanonical, canonical and grand canonical ensembles; density matrix and quantum statistics; ideal Bose gas: Bose-Einstein condensation, superfluidity, phonons in solids; ideal Fermi gas: electrons in metals; theory of Brownian motion: random walk, Langevin equation, Fokker-Planck equation.

First faculty meeting

The chairperson will call a faculty meeting immediately after the grading of the written qualifying examination. At this meeting the faculty may choose to pass some students on the basis of their performance on the written qualifying examination without a supplementary oral examination; these students will be informed by the chairperson of the faculty's decision. The other students who have taken the written qualifying examination will be asked to take an oral qualifying examination to supplement the written examination, provided the performance

was at a sufficient level to justify further examination.

Oral qualifying examination

An oral qualifying examination committee will be appointed by the chairperson to administer all oral examinations in a given year. This committee will give oral examinations to all students so specified in the first faculty meeting; the committee may use the results from the student's written qualifying examination in selecting topics for the oral examination. The committee is charged to administer these examinations as soon as practicable following the faculty meeting, and to recommend to the faculty an overall passing or failing decision for each student.

Second faculty meeting

At this meeting, the faculty decides to pass or fail students on the doctoral qualifying examination based on the results of the oral and written parts. Students who fail the qualifying examination for the Ph.D. may pursue an M.S. degree in physics, but in any event should consult with their advisors. It is expected that the process will be completed and the students notified of the outcome within four weeks of the written examination date.

Research Oral Examination and Candidacy

Within a year after passing the qualifying examination students are expected to obtain a faculty advisor to supervise their dissertation research. The Research Oral Examination is based on material related to the student's dissertation area. It should be taken no later than at the end of the student's third year. The examination is administered by a committee chosen by the student that includes his/her prospective dissertation advisor. A student is formally "**advanced to candidacy**" upon completion of the research oral and all course requirements.

The student is required to take an oral examination dealing with the plan for his/her proposed (or a possible) research topic. **The examination must be taken before the middle of the third year of graduate study (e.g. end of Fall semester, if student entered in Fall).** The student should have a tentative arrangement for a thesis advisor prior to this examination. The examining committee will consist of three physics faculty members, usually with the tentative thesis advisor as chairman. This examining committee is selected by mutual agreement among the student, thesis advisor and the chairperson. The tentative thesis advisor should arrange the examination. The choice of topic for the examination is primarily up to the student, subject to approval of the committee chairman. The student will prepare a short paper on this topic and distribute it to the committee one week prior to the examination. The oral examination will be based mainly on this paper and related questions. The student will be informed of the decision immediately after the examination.

Oral Dissertation Examination

This examination is based on the contents of the Ph.D. candidate's written dissertation, and is intended to ensure that the dissertation represents independent original research by the candidate at a standard satisfactory to the examination committee. The examination is governed by rules as specified by the Graduate School.

Options for students failing any of the required examinations are deliberated by the faculty.

Dissertation Credit

There is a dissertation credit requirement that can be satisfied in either of the following two ways:

- by taking 30 credit hours of PHY 999
- by maintaining "full time" status from the date of matriculation until all other Ph.D. requirements have been completed. Here "full time" means the student takes either at least 12 credit hours, or is a graduate assistant and takes at least 9 credit hours each semester.

The Waiving of Course Requirements:

The Graduate Committee of the Department of Physics may waive some of the requirements, if the student is able to establish that he or she possesses equivalent knowledge.

IMPORTANT NOTE

It is desirable that all students make application for a Master's degree, after satisfying the appropriate requirements. See section 3 of

"Comprehensive Examination and Master's Requirements." This does not involve any additional requirements for Ph.D. students.

Those students who wish to transfer to the Biophysics, Science Teaching, or Solid State Science and Technology programs should obtain the required information from the respective program directors. It is also possible to be dually enrolled in two graduate programs.

Research

After passing the qualifying examination, a student should consult with various members of the faculty who conduct research in the area that the student is most interested in pursuing toward a dissertation. As thesis advising is a highly personal relationship between the two individuals involved, and, as the availability of a particular member of the faculty may be affected by previous commitments, the department cannot guarantee satisfactory arrangements in this respect, even though a student has passed the qualifying examination. Though the physics faculty will try to help in resolving difficulties, finding a thesis advisor must remain the student's responsibility.

After the student has passed the research oral examination, the examining committee will become his/her research committee. The student will meet with the committee at least yearly. At these meetings, the student will report on research progress and plans.

Once the student has prepared his/her dissertation to the satisfaction of the advisor, the student must arrange for the defense. The dissertation must be presented to the Graduate School at least two weeks before the date set for the defense. At that time, the student must have his/her completed program approved by his/her advisor and by the department chairperson. They will then set up a full committee for the final defense and set a date. This committee will include the members of the research committee. The required "second reader" of the dissertation will be designated by the research committee.

Requirements for the Master's Degree

These policies are adopted by the faculty of the Department of Physics. Certain aspects are subject to approval by the Graduate School and the University Senate. Dates of adoption not established.

A minimum of 30 credit hours is required for the Master's Degree. All of these must be in courses numbered 500 or above. These courses must include Physics 581, 614, 621, 641, 661, and 662. A "B" average (3.0) in course work must be maintained for the student to be eligible for a degree.

The degree can be achieved in any of three ways:

- A thesis (involving 6 credit hours of Physics 997) in addition to 24 hours of regular course work.
- 30 hours of course work including a Minor Problem (Physics 890), and passing the Qualifying Examination (see Ph.D. above).
- 36 hours of course work and passing the Qualifying Examination.

Note: Not more than one semester of Physics 690 or 890 (3 credit hours each) can count toward the Master's degree.

The Graduate School requires that a student fill out a Tentative "Program of Study" and a diploma request card. They must be signed by the advisor and the chairperson of the department.

Support for Graduate Students Enrolled for Physics Degrees

These policies are established by the Chair of the Department and the Dean of the Graduate School.

General Policy

- a. Each graduate student will be given a maximum of 6 years of support, in any form, by the university. At the end of the 5th year of support, if he/she still needs a 6th year, the chairperson will send him/her a letter saying that the 6th year will be the last year of support.
- b. An advanced graduate who passes the qualifying examination on arrival will be given a maximum of 5 years of support.
- c. Any faculty member who is serving as advisor for a student, may request that an exception be made for a specific reason.
- d. Note the following requirement from *Academic Rules and Regulations*, 1994-1995: "A candidate for the doctorate who fails to complete his or her dissertation within five years after passing the qualifying examination and who, subsequently, seeks to complete the doctorate will be required to repeat the qualifying examination unless a petition for an extension of time is approved by the Graduate School."

Conditions for Continuation as a Teaching Assistant

As of September 1999, appointment letters for teaching assistants enrolled in physics graduate degree programs contain the following statements regarding the conditions for continuation of a teaching assistantship from the Department of Physics. These conditions also apply to teaching assistants who receive part of their support as research assistants.

"Your graduate teaching assistantship is contingent upon the following understandings. Failure to meet these contingencies or violation of University policies or procedures could result in the termination of your assistantship and/or scholarship.

1. You will perform your assigned assistantship tasks satisfactorily.
2. You will maintain your status as a full-time matriculated status as a graduate student at Syracuse University, and will maintain at least the minimum academic standard (3.0 grade point average) in each term.
3. You will make satisfactory progress toward fulfillment of degree requirements for the program (master's or doctoral) in which you are enrolled. If you wish to register for any courses not offered by the Department, you must obtain the written approval of the Department. Additionally, your principal advisor for thesis research must be a member of the Department of Physics faculty.
4. You will take on no additional work for pay during the period of this assistantship without the written permission of the Department Chair. The combination of your paid work, coursework and scholarly work are considered a full-time assignment.
5. In the event that the Teaching Assistant Program at Syracuse University finds your English language skill is below the standard set for teaching contact with students, you will enroll in recommended English courses and make satisfactory progress towards meeting the student-contact standard. Teaching assistantships may not be renewed for a second year for students who do not meet this standard."

Evaluation of Graduate Students

Students are admitted to the Physics Department under the assumption that they can fulfill at least the requirements for a Master's degree. Consequently those students who have been supported in their first year will in general be supported through their second year.

Exceptions to this policy may occur if there are serious problems, for example: inability to maintain at least a 3.0 average in course work, or repeated failure to fulfill requirements of a teaching assignment.

By the beginning of April of each year, the advisor of each graduate student should, and any faculty member may, deliver to the chairperson a report on the student's performance in teaching, research, and courses, with attention primarily to problem areas. Teaching evaluation will be the responsibility of the faculty supervisor for each course and must be provided each semester. Part of this evaluation should rest on observation of teaching performance in the classroom. Collection of teaching, research and course performance comments will be the responsibility of the advisor. Where problems are deemed to exist, the chairperson and advisor should promptly meet with the student. A formal written warning outlining the reasons for possible loss of financial support or matriculation may be issued to the student by the chairperson at this time.

Continuation of Financial Support/Graduate Matriculation

In January of each year, there will be a departmental review of all students. The Department will promptly notify those students who have previously been warned (see item 2 above) in case of termination of financial support and/or termination of matriculated status at the end of the semester. Students have the right to appeal the faculty's decision.

Policy on non-physics Courses

The following policy was a response to the increased number of graduate teaching assistants enrolled in the physics M.S. and Ph.D. programs who take courses outside the Department of Physics, in particular in the College of Engineering. The policy restricts the number of such courses each year to three for physics degree students supported in part or full as teaching assistants.

"Teaching assistantships awarded by the Department of Physics are used primarily to support students who are seeking the M.S. and Ph.D. degrees in physics. Consistent with this purpose, physics graduate students holding teaching assistantships are expected to restrict the number of (3 credit) courses they take outside of the physics department to one per semester, with one additional (3 credit) course taken over the summer. Although your course program should always be discussed with your advisor, non-physics courses may only be taken with the written approval of your advisor. English courses recommended by the Teaching Assistant program are excepted from these restrictions.

Physics graduate students who take more courses outside the Department than provided for by this policy will be assigned a lower priority in the awarding of teaching assistantships than are students pursuing the M.S. and Ph.D. degrees in physics as their principal activity."

Exceptional Circumstances

The faculty reserves the right to terminate support for a graduate student, and even his/her relationship with the department, for extremely poor academic performance or, in case of exceptional circumstances, where department, college or university regulations have been violated