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1. Orientation of New Students

New students are sent a letter in June describing guidelines used in selecting first-semester course assignments. At the start of the registration period for the first semester, the Department schedules an orientation meeting intended for answering students' questions pertaining to this manual and the graduate program in physics.

At the beginning of the Fall semester at Purdue, each new graduate student will be assigned an advisor. In case the assigned advisor is not available, students are assigned to Professor M. Haugan who will serve as a temporary advisor. Students are expected to discuss their academic progress with their advisor, who shall help them plan their curriculum for the first three or four semesters. All students will be required to file a Plan of Study with their advisor, no later than the Friday of the first week of classes. The completed Plan of Study will be forwarded to the Graduate Committee that will serve as the oversight body. Two "sample" Plans of Study are attached to this manual.

Students will be required to take a minimum of two physics courses per semester until the core is completed (provided that such courses are offered). These two can be either 500 or 600 level courses.

If the student has expressed a preference for a particular field of physics, the advisor will generally be a physics professor doing research in that field. A student who is a candidate for the master's degree must select the major professor (see 3 below) by the middle of the semester preceding the one in which the M.S. is expected to be received. A student approved by the Graduate Committee (see 4 below) for continuation into study for the Ph.D. degree must select the major professor for that degree at the earliest opportunity after certification.

2. Qualifying Examination

Graduate students in physics are required to take the Qualifying Examination upon entrance to Purdue. The exam consists of two 3-hour parts, and is scheduled twice a year, during the week immediately preceding the start of first- and second- semester classes. This examination requires a knowledge of classical mechanics at the level of the texts by Fowles, *Analytical Mechanics*, and Marion and Thornton, *Classical Dynamics of Particles and Systems*; of electricity and magnetism as presented in Griffiths, *Introduction to Electrodynamics* and Reitz, Milford and Christy, *Foundations of Electromagnetic Theory* and Marion, *Classical Electromagnetic Radiation*; of quantum physics at the level of French and Taylor, *An Introduction to Quantum Physics* and Eisberg and Resnick, *Quantum Physics of atoms, molecules, solids, nuclei, and particles*; and of Thermal physics as found in Kittel and Kroemer, *Thermal Physics*. Finally a general knowledge of modern physics at the level of the texts by Weidner and Sells, Krane, Sandin, Serway and Tipler is required.

All incoming graduate students are required to take the Qualifying Examination before the beginning of their first semester as a Purdue graduate student in physics. The full results of this diagnostic try will be used to help: (i) establish a student plan of study, and (ii) decide on the propriety of any core course equivalence request (see paragraph one in 6 below). Accordingly, the

full results of the diagnostic try will be made available to the student's advisor and to the Graduate Committee. The Graduate Committee will make final decisions regarding both plans of study and course equivalence requests. Incoming students who do poorly on the Qualifying Examination will not be granted course equivalences, and may not be permitted to enroll in graduate level courses without first achieving satisfactory results in 400 and 500-level courses. Students should be aware that no credit is awarded towards the doctorate for 400-level courses. Failure by students to take seriously the diagnostic attempt at the Qualifying Exam could substantially lengthen the time needed to complete the doctoral program, putting a student in jeopardy of exceeding the College of Science policy of allowing 7 years to complete the program.

For students entering without an M.S. degree from an institution in the United States, the first Qualifying Examination will be considered a mandatory diagnostic test in the sense that the full results will be recorded in the student's permanent records only in the event of a passing grade. However, in all cases, the results will be made available to the advisor (and to the Graduate Committee as appropriate) as described in the preceding paragraph. For students entering with an M.S. from a U.S. institution, the full results of the diagnostic try will be recorded in the student's permanent records in all cases.

Those who did not achieve a passing grade on the diagnostic test will be permitted two further consecutive attempts, the first one to be made no later than the beginning of their second semester of study at Purdue. (See also paragraph four in 6 below.) **Those entering with an M.S. from a U.S. granting institution are permitted only one further attempt, which is to be made no later than the beginning of their second semester of study at Purdue.**

The Qualifying Examination Committee consists of eight professors appointed by the Department Head so as to include representation of the major research fields within the Department. In preparing a particular examination, each professor prepares four questions (with solutions) for the consideration by the other committee members. The committee meets to select 16 questions from this pool of questions. It is the policy of the committee to give reasonably uniform coverage of classical mechanics, electricity, magnetism, quantum physics, thermal physics and general modern physics and to choose some questions that combine two or more of these fields. A mix of easy, moderate, and difficult problems is selected. An attempt is made to split these problems into two 3-hour exams of equal difficulty.

The maximum total score possible is 160. Each problem on the exam is graded by a single professor in order to provide uniformity in the assignment of partial credit. When the grading is complete, the committee meets again to set the "passing cutoff". This standard is not based on an *a priori* fixed score (or percentage of students passing), but represents the professional judgment of eight physicists about the minimum knowledge of the covered topics which is indicative of a good prognosis for completing the Ph.D. requirements. Each test is graded and the passing cutoff set with each examination paper identified only by a number rather than the student's name. The student's rank on the exam becomes part of the student's academic record. If a student passes the Qualifying Examination on the diagnostic try, this will be also explicitly specified in the student's record.

A student's failure on all the allowed attempts at the Qualifying Examination constitutes sufficient evidence to deny candidacy for the Ph.D. degree. Such students may receive the M.S. degree if they meet the requirements for that degree (see 5 below, especially paragraph (2)) and file the required Plan of Study.

3. Selection of Major Professor

During the first semester in the Department, a student should become acquainted with possible areas of work for specialization, by talking to the professors directing work in these fields, and learning about the research programs conducted under their direction. The seminar-type course for new graduate students, PHYS 696, as described in 6 below, will help the student to become familiar with the research activities of the Department.

The major professor for the M.S. degree should be chosen as soon as practicable, but *no later than the time that the student preregisters for the semester in which the M.S. degree is expected.*

The major professor will direct the student in preparing the M.S. Plan of Study, will advise on the selection of courses, and will direct any thesis research undertaken in connection with the M.S. Thesis Option. (See 4 below for the selection of a major professor by a Ph.D. student.)

After the student has discussed plans with the proposed major professor and has obtained the professor's permission to work with him, the student must obtain a copy of the major-professor form from the Graduate Office, fill it out, and return it to the Graduate Office.

4. The Advisory Committee and the Plan of Study

The student and the major professor cooperate in the preparation of the Plan of Study for the M.S. degree. The completed Plan for the M.S. degree must be filed with the Graduate School Office *no later than the end of the semester preceding the semester in which the M.S. is to be awarded*, i.e. by December for a May degree. This plan is normally identical to the Physics Department Plan of Study on file. See 6 for information about filing the Ph.D. Plan of Study.

The preparation of the Plan of Study entails the selection of the student's Advisory Committee. The major professor acts as Chairman of this committee. An M.S. Committee consists of a minimum of three persons, including the Chairman. One of the other two members must be a physics professor, and the remaining member will be from physics or from a department in which the student takes a minor program of six hours or more. The Ph.D. Committee is composed of the major professor acting as Chair, and three additional Physics Professors chosen by the major professor with input from the student. One of the three Physics professors may be replaced by a professor from another department provided he or she is working in an area of research closely related to the student's field of research.

The functions of the Advisory Committee are to monitor the student's progress and to approve the courses listed in the Plan of Study and, if possible, to serve as the examining committee for examinations such as the M.S. final, the Ph.D. preliminary, and the Ph.D. final. Course requirements, and associated quality standards, for the M.S. and Ph.D. degrees in physics, are discussed in 5 and 6 below.

A request for changes in an approved Plan of Study is made by addressing a form 13 to the Dean of the Graduate School. The proposed changes and the reasons for making them are explained. The

form is to be signed by the student, the members of the Advisory Committee, and the Head of the Department.

5. Requirements for the M.S. Degree

Most candidates for the M.S. degree take the degree under the non-thesis option, but a thesis option is available for those students for whom research experience seems particularly desirable, provided a physics professor agrees to supervise the work. Any student entering the department without an M.S. degree will be strongly urged to obtain the M.S. degree during the course of study at Purdue. For some students this will be a terminal degree, but most physics graduate students plan to continue their studies beyond the M.S. level. As explained below, such students can satisfy the non-thesis M.S. requirements without delaying progress toward the Ph.D. degree. The effort required, beyond that entailed in a Ph.D. program, consists of preparing an M.S. Plan of Study and paying the M.S. diploma fee. The Ph.D. candidate profits by having an earned graduate degree in physics in case unforeseen circumstances cause an interruption or termination of Ph.D. studies.

Students who enter the graduate program with the intent of terminating with a M.S. degree must pass the Qualifying Examination at the M.S. degree level.

The Master's degrees offered by the physics department are:

- **Non-Thesis Option:**

30 credit hours of course work required at the 500-600 level, including two math courses and a laboratory course.

The qualifying exam must be passed at the Master's level.

Specific requirements for the degree of Master of Science in the Department of Physics on the non-thesis option are:

- (1): The satisfactory completion of 24 credit hours of 500-600 level courses in physics, including one laboratory course; and in addition, 6 credit hours of 500-600 level courses in mathematics (these may be replaced in whole or in part by PHYS 600, 601). In order to count toward the satisfying of this requirement, the grade in a 500 level physics course must be A or B, and the grade in a 600 level physics course must be A, B, or C. In both 500 and 600 level mathematics courses A, B, and C are satisfactory grades. The particular courses to be taken by a given student are listed in the Plan of Study, which must be approved by the Advisory Committee, the Head of the Department, and the Dean of the Graduate School. After the Plan of Study has been approved and filed, the course selection may be amended by written application to the Dean of the Graduate School (see 4 above).
- (2): A score on the Qualifying Examination which is no lower than 25 points below the "passing cutoff" or at a level deemed appropriate by the Qualifying Exam Committee (see 2 above). The

Qualifying Examination usually serves as the written examination for the M.S. degree, but the Advisory Committee has the authority to require an additional written examination. (It also may, at its discretion, require an oral examination.)

(3): A grade index of 2.80/4.00 or higher. The Registrar's Office deletes the first grade from a student's graduation index if that specific course was originally taken while the student was enrolled as a graduate student and is subsequently repeated for credit and a grade. Grades earned prior to the 1995 summer session are not to be deleted. The graduation index for graduate students will include all grades earned in 500- and 600-level courses taken while enrolled as a graduate student, plus grades received in up to 6 hours of approved 300 and 400 undergraduate-level courses taken while in the graduate program (Section VII B.1a (1) of Graduate School Manual) once they are approved as part of the graduate plan of study. (Thus, grades earned in any undergraduate courses taken after the 1995 spring semester will not be part of the graduation index shown on the grade report. Upon the request of the major professor, those grades will be added into the graduation index once they are listed on the approved plan of study.)

- **Thesis Option:**

21 credit hours of course work are required, including 15 hours of Physics Courses at the 500-600 level, and two Mathematics courses . In addition, 9 hours of physics research (**PHYS 698**) are required.

The Qualifying Examination must be passed at or above the Master's level

The course requirements for the M.S. degree on the thesis option are reduced to 15 credit hours in physics and 6 credit hours in mathematics (which may be replaced in whole or part by PHYS 600, 601). The quality requirements are the same as listed in **(1)** above. Requirements **(2)** and **(3)** must also be satisfied. The final oral examination will deal with the thesis research as well as courses taken. Other requirements, such as GPA, are same as for Non-thesis option.

- **MS in Applied Physics:**

Students who receive a BS in Applied Physics at Purdue with at least a 3.0 grade-point average may be admitted to a program leading to an MS in applied Physics that can be completed in one year. 30 credit hours, including 12 of physics courses at 500-600 level and 18 of applied electives.

Graduate students should recognize the fact that their progress in graduate school will be measured by their grades, the quality of their research, and their performance in carrying out their duties as teaching or research assistants. An evaluation of each student is made each semester, and is used in determining whether the student is to be permitted to continue in graduate work.

At the close of each term, the Graduate School audits the records of all students and brings a low standing to the attention of any student who has either a semester or cumulative index less than 2.80.

6. Requirements for the Ph.D. Degree

A Plan of Study for the Ph.D. degree should give the student a relatively broad acquaintance with the general field of physics and form a firm basis for specialization and thesis research. No fixed number of credit hours is required, but Ph.D. candidates are required to complete the core program described in (1) below. The courses on the Plan of Study are divided into two categories: those in the primary area (physics) and those in related areas (e.g. mathematics, chemistry). The specific requirements that must be satisfied by a Ph.D. candidate in the Department are:

(1): The following *core program* of courses must be satisfactorily completed:

PHYS 617 (Statistical Mechanics)

PHYS 630 (Advanced Theory of Electricity and Magnetism I)

PHYS 660 and 661 (Quantum Mechanics I and II)

In addition, each graduate student must take 3 additional specialty courses within the Physics Department. Any specialty course taken outside of the Physics Department must be approved by the Graduate Oversight Committee. A student can be certified for the Ph.D. once the Qualifying Examination has been passed and the 4 physics core courses have been completed with the requisite GPA. Grade requirements for the core courses are described in (6) below. A core course need not be taken at Purdue if its true equivalent has been taken previously at another institution. An entering student may request equivalency in a core course by providing evidence of completion of a comparable course with a grade equivalent to an A or B. *A request for establishment of course equivalence must be filed by the student within one week of initial registration as a graduate student in the Department with the appropriate member of the Physics faculty responsible for teaching core courses.* The request form calls for the student to present pertinent material (text used, chapters covered, course level, etc.) about the course or courses submitted for equivalence rating. A copy of the request form must be provided by the student to his advisor. The faculty member will forward to the Graduate Committee those requests deemed worthy of consideration for granting course equivalence. The faculty member may require adequate performance on a special written or oral examination before recommending course equivalence. The Graduate Committee will grant or deny such requests, taking into account the results of the diagnostic attempt at the Qualifying Examination.

(2): In addition to the core and the specialty courses, the student may take (a) any 500 level courses that may be needed in order for a level of proficiency adequate for good performance in the core courses, (b) laboratory courses needed in preparation for the thesis research, (c) any courses recommended by the Advisory Committee to broaden preparation in physics, (d) an advanced course or courses in the field of specialization.

(3): PHYS 696 for all first-year students (usually taken 2nd semester).

(4): The Qualifying Examination (covering mechanics, electricity and magnetism and modern physics as described in 2) must have been passed in not more than two attempts before the end of the third semester in graduate school.

(5): The student must be *certified* as meeting departmental standards in physics. The usual minimum requirements for certification are:

(a) The Qualifying Examination has been passed and

- (b) the core courses have been completed, with a minimum grade-point average of 3.00/4.00 (B average) for those taken at Purdue.

Normally, the Graduate Committee will recommend that the student be certified when the above conditions have been met. In the event that the student's grade-point average is lower than 3.00, the Graduate Committee will review all available evidence on the quality of the student's performance. Each semester, before starting such reviews, the Committee will distribute to the Department Faculty a list of the students involved, and an invitation to provide relevant information. The Committee will also invite each student affected to provide information the student feels should be of help in the Committee's deliberations. On the basis of the review, which may include interviews with the student, the Committee will recommend to the faculty that the student be certified, be reconsidered after additional course work, or not be certified. Each notice that certification has not been granted by the Graduate Committee will be accompanied by a statement of the factors which entered into the decision. A student who has been denied certification may appeal if he or she believes that the procedures leading to the decision were defective, in that:

- (a) considerations other than academic were allowed to enter, or
- (b) valid academic considerations were excluded.

In such a case, the student should present to the Graduate Committee a detailed allegation of the flaws in the procedure leading to the adverse decision. If the Graduate Committee decides that reexamination is not warranted, the original decision will stand. A student will normally be certified at the end of the third or fourth semester in graduate school. The time allowed to reach certification depends on the number of core courses a student must take. If no equivalences are granted, students are permitted six semesters to attain certification. This time will be shortened by one semester for every two equivalences granted. A student who has not been certified three calendar years (two and one-half years for those entering with an M.S. degree) from the date of first entry as a graduate student in Physics, can be certified subsequently *only* if the Graduate Committee deems that there exist extenuating circumstances of an unusual nature such as financial problems, sickness or a death in the family. In the latter case the period may be extended by at most one year by the Graduate Committee.

(6): After being certified by the Graduate Committee, the student shall arrange for the appointment of the Preliminary Examination Committee and the preparation, approval, and filing of the Ph.D. Plan of Study (which may contain no Physics 500 level course with a grade less than B and no 600 level course with a grade less than C). This committee, which will usually be the same as the Ph.D. Advisory Committee, shall be chaired by the probable major professor. It also includes a professor chosen by the chairman and the student, and two other professors designated by the Department through the Graduate Committee. These four are to include a theoretical physicist and an experimental physicist. The research specialty of one of the members must be outside the student's general research area. *Within six months* following certification, the student's Preliminary Examination Committee must meet to decide on the nature, coverage, and timing of the student's examination. The examination may have written and oral portions, but there will be no *department-wide* preliminary examination. *The student must take the examination for the first time within six months of the initial meeting of the Preliminary Examination Committee.* This committee will send the student a memorandum describing the nature of and preparation required for the examination. A copy of the memorandum will be placed in the student's file. The Graduate School must be notified of the time and place of the examination *at least two weeks in advance.* A student who fails the examination on the first attempt may be granted a second try by the Examination Committee. Appeals of the decisions of the Examination Committee may be made to the Graduate Committee.

Failure to:

- (a) convene a meeting of the student's Preliminary Examination Committee within six months following certification *and*
- (b) administer the Preliminary Examination within twelve months of certification

may result in the *suspension or termination of the student's Ph.D. program and/or financial support*. Any exemptions must be approved by the Graduate Committee. Any appeals or requests for deviation from the procedures outlined in this manual may be made in writing to the Graduate Committee.

(7): As a vital part of the graduate training program in physics, all Ph.D. candidates are required to be engaged in a training assignment each term. These assignments vary according to the needs and professional aspiration of the student and increase in responsibility as the student progresses. They are designed to supplement the more formal course work by a variety of pre-professional activities such as assisting in research and teaching, under staff supervision. The amount of time required of the student varies from 10 to 20 hours a week, depending upon his or her level of progress and type of assignment. The purpose of these assignments is to expose the student to some of the types of activities in which he or she ultimately will be engaged after receipt of the degree. Students from outside the United States may be excused from the training requirement because of their different purposes and needs. PHYS 670A (Pedagogical Methods for Physics Graduate Students; sem. 1, 2 credits) is required of all Graduate Teaching Assistants.

(8): As an integral part of the work toward the Ph.D. degree, the student is expected to regularly attend the general departmental colloquia and advanced seminars in his or her specialty.

(9): The thesis research must be carried out in such a way as to meet the standards set by the major professor and other members of the Advisory Committee. The research student is required to keep his or her Committee informed of progress in the research program and *to meet with it at least once a year for this purpose*. Upon completion of the research, the thesis is written with its *text* subject to approval by the major professor and its *format* subject to the regulations of the department and the Graduate School (see the "Policies and Procedures Manual of the Graduate School").

(10): The thesis material must be prepared for publication. The regulations of the Graduate School require the microfilming of the thesis. In addition, in the Department, the preparation of the appropriate scientific journal article is an essential part of the requirements for the degree.

(11): The final oral examination covers the thesis, the primary and related areas. The Examination Committee consists of at least four members and usually will be identical with the Advisory Committee. The time and place of the final examination is published so that interested faculty members and students may attend. The Dean of the Graduate School reserves the right to appoint additional members to the examining committee, and the Graduate School must be notified of the time and place proposed for the examination *at least two weeks in advance*.

(12): It is the student's responsibility to take care of the corrections, production of the cotton copy, microfilming, duplication of additional required copies, and binding of the copies for the thesis. There is at least one commercial copy shop that can help you with this. Departmental secretaries are not to be asked to do this on departmental time. If a student pays a secretary to do the job in his/her time after hours, the department has nothing to say about it.

(13): The PCN FAQ facility, which includes information on Latex, can be found at <http://www.physics.purdue.edu/PCN/fomserve/cache/1.html> under Documentation. The Latex Purdue thesis style website is at <http://www.ecn.purdue.edu/ECN/Documents/thesis/>.

7. Policy on Length of Study for Ph.D.

The policy of the College of Science shall be that seven years from entry into the graduate program (i.e., 14 semesters plus the intervening summers plus one additional summer to finish if necessary) be the maximum time allowed to complete the Ph.D. in the College of Science. An additional year may be allowed if requested by the student's Thesis Committee and approved by the department's Graduate Studies Committee. Any exceptions to this policy will require approval by the Department Head.

After 10 semesters in the Ph.D. program, each student and his/her thesis committee will receive a letter from the Graduate Committee reminding them of the expectation of completing the Ph.D. within 7 years of entering the program. The student and his/her committee members will be asked to reply to the Graduate Committee in writing, stating the feasibility of finishing within 7 years.

After 12 semesters, the Graduate Committee will request of the student and his/her committee a specific schedule for completion of the doctorate. This schedule shall be communicated to the Graduate Committee by a letter signed by both the student and the members of the student's Ph.D. committee.

After 14 semesters, the Graduate Committee will specify the completion date for the Ph.D. in a letter to the student and his/her committee. The student will accordingly not be permitted to enroll in the semester immediately following the specified completion date. The student's committee can appeal this decision. The Graduate Committee will consider such appeals on a case-by-case basis.

8. International Students: Oral English Proficiency Program (OEPP).

The University has instituted an Oral English Proficiency Program (OEPP) to ensure that language and cultural barriers do not diminish the effectiveness of instructors whose native language is not English and who have not had experience in American undergraduate colleges.

Non-native English speaking graduate teaching assistants (GTAs) are required to take the OEPP screening upon entrance and pass it at the level of contact teaching or, in case of failure, to register for the remedial oral English course in the first semester. Immediately after arrival on campus, international students should make arrangements with Sandy Formica, Graduate Secretary, to schedule the OEPP screening during the orientation period. As a result of these evaluations, registration may be required in a special course, English 001T, "Oral Communication Skills for International Teaching Assistants/Instructors". The English 001T instructors can grant the OEPP certification at the end of semester. Please, remember that the passing grade for English 001T is not equivalent to the OEPP certification.

The satisfaction of this requirement is an important part of job performance, on which the level of subsequent financial support will be based, including the teaching opportunity during the summer session. Students from India, Bangladesh and Pakistan are also required to take this test. International students who would not get the OEPP certification within the first two years at Purdue are not eligible for a teaching assistantship. The two-year limit does not apply to research assistants.

Any exceptions to this policy will require approval by the Department Head.

9. Graduate Student Ombudspersons and Appeals

Graduate students with problems related to interactions with other graduate students, faculty, or staff, or those related to their teaching duties, or academic work which cannot be resolved through their academic advisor, have at their disposal a mechanism for addressing such issues. The Department of Physics has two faculty members who serve as Ombudspersons. It is their responsibility to help graduate students resolve these types of problems. If you have such a problem, please contact either Professor Bortoletto or Professor Giordano. If the problem still cannot be resolved, please bring the matter to the attention of the Physics Department Head.

A student who is in jeopardy of being terminated from the graduate program because he or she has not maintained satisfactory progress toward completion of the program requirements may appeal to the Graduate Committee for reconsideration.