

BROWN UNIVERSITY

NOTES ON THE GRADUATE PROGRAM IN PHYSICS

These notes are addressed to all current and incoming graduate students in Physics--for the first year as a guide to planning activities, for later as a checklist on progress. The University Catalogue is the primary reference for degree requirements and options.

February 2011

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A. INTRODUCTION

The aim of the Graduate Program in Physics is to train professional physicists of high competence, a state interpreted as including both a mastery of the fundamental principles, facts and methods of the discipline and the capability to plan and carry out original investigations leading to new and useful knowledge. The program is research-oriented and biased toward the Ph.D. It is not career-oriented or slanted toward specific fields of specialization. The temporary specialization demanded by a student's research is conceived as a part of the academic experience and in many cases will be abandoned upon graduation, entailing neither loss nor waste. Similarly the advanced Degree in Physics imposes no career commitment. It certifies a command of certain intellectual tools of broad validity, physics' modes of thought and of attacking the unknown. The Physics Degree includes, but is not limited to, a license to practice research and/or teaching in Physics.

These aims underlie the two broad phases of the graduate program: courses and research. The intent is to retain the maximum of individual freedom which is consistent with attainment and demonstration of a professional level of competence in both phases. The system of grades, examinations and associated requirements has three functions: to certify achievement of the program objectives, to monitor progress toward them, and to identify students of highest promise and accomplishment in a systematic way. They are meant to protect the University against devaluation of its degrees, the student against an unprofitable investment of time and effort, and both against the ineffective distribution of limited resources for financial support.

Faculty members are willing and able to give information, advice and assistance at all stages of graduate work. They feel a real interest in the individual student, a stake in his/her present progress and future career, and respect for his/her privacy and dignity as a person. The student/faculty ratio has remained low, contact is meant to be informal and unconstrained, and each student should come to know and be known by a number of faculty members in a short time. The number and effectiveness of these interpersonal contacts depends largely on the student's own initiative. In general, faculty members will not seek a student out but will welcome him/her.

B. COUNSELING AND COMMUNICATION

The Department has traditionally been distinguished by a relaxed and informal interaction among its faculty members and graduate students. We count this tradition as one of our assets and consciously seek to preserve it, but to do so we must now rely more heavily on mechanisms of contact and on student initiative than when more people were involved. Course contacts, seminars and colloquia are convenient occasions to become acquainted with faculty members.

No less important than interaction with the faculty, and equally dependent upon a voluntary effort to communicate, is the communication among graduate students at various levels of advancement. The grapevine is a unique and important source of information which should not be neglected. Do not hesitate to ask other students questions.

Formal mechanisms for faculty counseling are currently limited to three. Each student's first-year course program is discussed with him/her upon entrance in light of his/her background and aims. Once an association with a research supervisor has been established (usually at the end of the first year), this association forms the one-to-one relationship, which is the primary counseling mechanism. Finally, one faculty member is designated Director of Graduate Studies, who chairs a Graduate Advising Committee. The responsibilities of this committee include providing an open line for communication with the faculty as a whole on matters of general or

individual concern, individual counseling services (available at all stages but of particular importance in the period before a research affiliation is established), an awareness of each student's progress within the graduate program, and a liaison with the Graduate School. A department staff member serves as the Graduate Coordinator and is available to assist you with all other graduate matters.

There are several ad hoc committees and individual positions to deal with specific matters. The complete list of Departmental Committee duties is available from Kathy Brobisky, Room 406. Some of these that are of interest to students are:

- Graduate Advising Committee
- Committee on Graduate Curriculum
- Colloquium/Seminar Committee
- Library (Dept., Rm. 537) and Representative, Sciences Library
- Qualifying and Preliminary Exam Committee
- Committee on Graduate Student Admission
- Shop Committee
- T.A. Training Committee

C. DIGEST OF PROGRAM AND REQUIREMENTS

In brief, the Ph.D. candidate first completes six prescribed core courses and then conducts an original investigation under the sponsorship of a particular faculty member (research supervisor), at the same time taking at least four advanced courses to bring his/her knowledge of the chosen specialty to research level.

The first year is spent wholly on the prescribed courses, although it is highly desirable that a research field be chosen and, if possible, an understanding reached with a research supervisor before the end of that year. In the second year the core courses are concluded, one or two advanced courses taken in the chosen specialty area, and active work is begun with a research group, usually participation in ongoing projects for orientation and assimilation of the ways and means of the selected research area. In the third year formal course work usually ends with two more advanced courses. An independent research project gets underway, thereafter absorbing the student's full effort until it is completed and embodied in the formal thesis.

The Department has adopted the following **Criteria Defining the Standing of Graduate Students**:

The following criteria defining Good Standing also set out the normal progress of a Physics graduate student's career at Brown. Every student admitted to the graduate Physics program enters in Good Standing, and it is the expectation and desire of the Physics Faculty that all Physics graduate students will remain in Good Standing, completing a Ph.D. degree.

Students appointed as Teaching Assistants or Research Assistants are required to take three full courses per semester. Students holding Brown University or U.S. Government sponsored scholarships or Fellowships are required to take four full courses per semester. Reading and research courses may only be taken by first year students either as a fourth course or under special circumstances with permission of the Director of Graduate Studies. Note: You cannot drop a course without consulting with the Director of Graduate Studies first!!

A student will be in Good Standing if he or she:

- A. Passes three approved courses each semester if a Teaching Assistant, or four courses if holding a Fellowship, after two semesters of graduate study at Brown; then passes or is excused from taking the remainder of the "core" courses by the end of four semesters of graduate study at Brown and achieves the following core course grade record: no N.C.'s and at least 50% B's or better by the end of two semesters and no remaining N.C.'s or I's and 50% B's or better by the end of four semesters.
- B. Passes the Qualifying Exam and receives faculty approval to continue a graduate career in Physics by the end of his or her fourth semester of graduate study at Brown.
- C. Establishes a plan for financial support with a research advisor who can guide his or her PhD research effort within two semesters of passing the qualifying exam or by the start of his or her fifth semester of graduate study, whichever comes first. The relationship with the research advisor is expected to remain through the student's PhD study. This relationship and the associated plan of support must be endorsed by the department chair.
- D. Passes the Preliminary Oral Exam by the end of the sixth semester of graduate study at Brown.
- E. Satisfactorily performs any teaching and/or research duties.

A student failing to meet at least one of these criteria is not in Good Standing unless a prior exception has been made by the Department Chair in consultation with the Director of Graduate Studies. Examples of exceptional circumstances include illness, inadequate preparation for some graduate courses and/or postponement of the Qualifying Exam, or personal problems. A record of any exception and the relevant reasons will be kept by the Chair and the Director of Graduate Studies along with each student's course grades, Qualifying and Preliminary Exam results and current standing.

It is expected that all core courses will be taught and taken ABC/NC. For any Physics graduate student who passes a core course with an S, the instructor will prepare an evaluation form for the Chair, which evaluation will include an equivalent ABC letter grade for use in establishing standing.

It is anticipated that students in Good Standing will so continue. It is also anticipated that in addition to the requirements in A. above, students will perform satisfactorily in all courses. Records of course grades will be kept by the Director of Graduate Studies, whose responsibility it is to inform the faculty if an advanced graduate student (third year or beyond) is not doing satisfactorily in courses. The faculty may then act. At an appropriate meeting, the Physics Faculty will discuss the performance of graduate students. Those fulfilling the above criteria are assured automatic Good Standing. The standing of those students who do not meet these criteria will then be discussed by the Faculty.

In addition, if a student is not in Good Standing, then either: the Department Chair, after consultation with the Director of Graduate Studies and the student's research supervisor (if there is one), may discontinue the student's teaching assistantship if the student has not been taken on as a research assistant, or the research supervisor after consultation with the Department Chair and the Director of Graduate Studies may discontinue the student's research assistantship. These decisions will be communicated to the student and the Physics Faculty in writing as soon as possible.

The **Qualifying Examination** normally taken at the start of the second year is the Department's primary instrument for admitting students into the upper levels of the Ph.D. program. Its purpose is to evaluate whether a student's understanding of fundamental general physics is adequate for success in independent physics research. It may be taken in the spring of the first year by prepared students (permitting an earlier start on research), or deferred in the case of a first-year program that did not include the normal complement of core courses. See the appendix for more details.

The **Preliminary Examination**, which should be taken during the third year, evaluates a student's ability to understand and orally convey a physics research topic of current interest.

PROCEDURES FOR THE PRELIMINARY EXAMINATION

- At least two weeks prior to taking the Preliminary Exam, a student submits an abstract to a three person faculty committee, whom they have chosen in consultation with their research advisor by the end of the **second year**. This committee should include the research advisor. The abstract provides a brief description (approximately one typed 8-1/2 x 11 page in length) of the topics that the student will present and in which they are willing to be tested during the exam. The topic may be in the area of the student's research or may represent a specific research paper, provided its subject is dealt with in sufficient generality, perhaps preceded by an appropriate introduction formulated by the student.

- The first forty minutes of the exam is devoted to a prepared presentation by the student. He/She should expect questions, based upon his/her graduate course work and relevant to the topic under discussion.
- A two-thirds favorable vote is necessary to pass. The exam may be retaken as needed.

After the Ph.D. thesis is completed and approved, there is a **Final (Oral) Examination**-- often called **defense of the thesis**. Rules of the Graduate School require that this Final Examination take place within five years after the Preliminary Examination, unless special circumstances justify an extension. The sense of Preliminary can now be seen: the two examinations mark the formal beginning and completion of the independent research work. In general the Thesis Defense Committee will consist of the same faculty who served on the student's Preliminary Exam, though changes can be made in consultation with the research advisor. These faculty will function as research and career mentors to the student over the course of his/her thesis work.

An aggregate of three years of full-time study while in residence at Brown is required and is automatically satisfied in the normal program of classroom and research courses. It may be possible to meet part of this requirement by transfer of credit from another institution.

It is the individual student's responsibility to make sure, before appearing for the Final Examination, that all of his/her Departmental and University requirements have been met.

The **Master's Degree in this Department (Sc.M.)** at present is not a simple recognition of a year of graduate work. It stands for a genuine and honorable level of achievement, different in kind as in level from undergraduate study. Its minimum requirements consist of eight courses. These would normally be 2000-level Physics courses, e.g., the core courses Physics 2010, 2030, 2040, 2050, 2060, 2140. Other courses outside the Department or 1000-level courses could be substituted by permission of the Physics Department. No more than two courses can be research courses. At least half of the grades in the core courses and in the 1000-level courses must be B's or better under the ABC/NC option, or must represent performance of equivalent quality under the S/NC option (a written recommendation from the instructor will be required in this case) or else the student must have passed the Qualifying Examination for the Ph.D. in Physics.

Ordinarily a thesis is not required for the Sc.M., but the Department reserves the right to require a thesis in special cases. Such a decision is made no later than one semester after the student announces to the Department Chair his/her candidacy for a Master's Degree in Physics.

D. COURSES

The six prescribed **core courses** are:

Physics 2010	Laboratory Course
Physics 2030, 2040	Classical Theoretical Physics I & II
Physics 2050, 2060	Quantum Mechanics
Physics 2140	Statistical Mechanics

No student should be asked to repeat work already done, and those who believe they have substantially covered the content of any of the core courses should ask (at their first registration conference, or of the Director of Graduate Studies at any time) to be excused from

taking the corresponding course(s) in the list above. Conversely, significant gaps in undergraduate preparation are sometimes filled by taking one or more 1000-level courses in the first year. Such courses carry full graduate credit if the grade is B or better.

After the first semester, a student who has done graduate work before coming to Brown may request transfer credit for courses so taken, provided their content does not duplicate course work he/she has done or will do at Brown, subject to a limit of eight courses (Ph.D.) or one course (Sc.M.). Such a transfer of credit in effect incorporates the courses into the Brown program. Although a given course taken elsewhere may qualify both for a credit transfer and a waiver of one of this Department's core courses, this is not necessarily so:

- A waiver excuses the student from one of the Department's required courses but does not contribute to either residence or tuition requirements.
- A credit transfer reduces both of the latter, but may have no effect on the Department's specific course requirement.

Beyond the core courses, Ph.D. candidates are expected to pass four advanced courses, in addition to research courses, to strengthen and update their knowledge of their chosen research fields. The student's own taste and the supervisor's recommendations are both vital guides at this point, and it should be possible to accommodate both. At least two of these advanced courses have to be chosen from the 2000 level courses offered by the Physics department. The rest can be from offerings of other departments subject to the approval of the Director of Graduate Studies. The Department's offerings at this level vary from year to year. The student should consult the Department's annual listing of course announcements. Special courses can sometimes be arranged in response to student requests, given sufficient numbers and sufficient warning. Reading courses can only be counted towards the advanced course requirement upon approval by the Director of Graduate Studies, who will consult with the reading course supervisor.

The sequence of advanced courses in the various fields of specialization shades almost imperceptibly into the various weekly series of topical seminars and departmental colloquia. These are a major constituent of the graduate program, and regular attendance and occasional participation are expected of each student. They provide not only contact with the current literature but also a first-hand experience in professional Physics research. (It is possible to learn also from less exciting visiting speakers as well as the most stimulating ones.)

The normal full-time course load for Teaching or Research Assistants is three courses at a time, and four for others. After the first year fewer classroom courses are taken and a full-time registration is maintained by the assignment of course credits for research activity (designated PHYS2980). If all core and advanced courses have been taken, registration should be for Research (PHYS2980) Triple credit each semester until 24 tuition credits have accrued. After 24 tuition credits have been accumulated, Thesis Preparation (PHYS2990) is usually the appropriate course to take. A similar adjustment is occasionally made in the first year, e.g., in the cases of foreign students for whom special work in English is recommended. The concept of full-time load is federally defined prerequisite for the tenure of federal fellowships.

Individual course registrations are submitted online via the University's Banner registration system.

E. THE RESEARCH COMPONENT IN GRADUATE STUDY

Most students enter graduate school without a clear preconception of which specific research field attracts them most strongly. It is an important function of the first year to evoke such a preference, through courses, colloquia and seminars, and informal discussions with faculty and other graduate students. The primary aim should be to establish a choice of field before the end of the first year, so that active association with a research group can begin during the first summer at Brown. It is not intended to force a premature choice; changes of direction are possible, but the sooner a reasoned choice can be made and acted upon, the smoother will be the transition from course work to research. It should be clearly understood that a Teaching Assistantship in the second year is in no way guaranteed (See also: FINANCIAL SUPPORT).

Establishment of a research connection obviously requires not only concentrated thought but substantial initiative on the part of the individual concerned. Three steps are involved:

- learning what kinds of work are going on and hence what is available
- estimating what your opportunities, duties and daily life might be in those groups that interest you
- establishing a personal connection

Colloquia and seminars (especially those specifically reviewing current Departmental activities), the Department's brochure and discussions with the Director of Graduate Studies or any faculty member with whom you have become acquainted will help in the first stage. You should talk at length with graduate students and supervisors in the groups that interest you. The last, of course, is accomplished by a direct approach to the Faculty member with whom you would like to work, an expression of your interest and a request that you be accepted as a research student. You should begin this process well before the end of Semester II.

The Department aims at giving all possible freedom to every student in the choice of doctoral research, including the right to change fields for good reason. However, practical obstacles may arise--notably, that the preferred research group or groups cannot at that time handle any more students. It is very important that students explore a variety of research opportunities across several fields of physics.

Subject to the annual availability of funds, the Department considers itself obligated to continue financial support of students admitted with support--under some provisos. These are that, reciprocally, such students:

- are expected to remain in good academic standing,
- to perform well whatever duties are connected with support (e.g., teaching for teaching assistants),
- to pass, in turn, the Qualifying and Preliminary Examinations, and
- to evidence both ability and effort in Ph.D. research.

Interdepartmental research projects carried out entirely in a related department are possible in connection with a Ph.D. in Physics. Specific proposals should be discussed, in advance of any commitment, with the Advisor as well as with the outside Faculty Members who may be involved. In such cases a Physics Faculty Member is associated with the program as liaison, the student is subject to the normal Physics Department requirements, and the thesis must be approved by both departments involved.

The Department assumes proper Ph.D. research to be of publishable quality, and thesis results are expected to be published in the professional literature. In all stages of the work the supervisor has the primary role in evaluating the quality of the research. The research proposal may be considered by other faculty members in the student's Preliminary Examination, and the completed project should be approved by thesis readers representing the Department. A member of another department may also act in this role if his familiarity with the project is adequate. In general, the thesis readers will be the same faculty who served on the student's Prelim Exam committee, though changes can be made in consultation with the research advisor. The members of the Prelim Exam can thus be drawn upon for informal counseling while the research is in progress. As to the technicalities of preparing a thesis (for both degrees) and the procedures and deadline of the final semester of the Ph.D. program, condensed guides are available from the Graduate School and from the Office of the Chair.

F. TEACHING EXPERIENCE

In addition to being the duty for teaching assistants, teaching experience is an integral part of graduate study in Physics at Brown. Certainly such experience would be valuable to those who aim toward careers involving teaching. Now, as in the past, some academic people believe that teaching experience has relevance in graduate education comparable to that of research.

It is still true that more than half of our Physics graduate students hold teaching assistantships for at least a year (usually the first). The Department will do its best to accommodate students who want to do some or some more teaching, perhaps later in their program. Also the Sheridan Center for Teaching and Learning sponsors many events, seminars and forums open to the entire Brown Community.

For all those interested in the philosophy, strategy and techniques of teaching, close attention to those aspects of the weekly colloquia will provide both good and not so good case studies.

At the start of each year, discussion sections are conducted by Faculty, Staff and Administrators to introduce new Teaching Assistants to their duties and privileges. It is expected that all Teaching Assistants will attend these sessions when notified.

G. FINANCIAL SUPPORT

Because they are not yet fully prepared for research, most first-year students who are not supported by fellowships are teaching assistants (TA's). Support as a TA for a second year is not guaranteed. As soon as possible thereafter, students should try for research assistantships (RA's), which (Section E above) requires a combination of acceptance and current availability of funds in a research project. TA's are supported from the University's instructional budget or, rather, the part of it specifically allocated to Physics each year for this purpose. Stipends for RA's come out of those specific contracts or grants--mainly from the Federal Government--that support research projects. A TA's duties are normally in the laboratory component of either an undergraduate or a graduate course. An RA initially goes through the equivalent of on-the-job training and as soon as possible progresses to an individual topic expected to culminate in a Ph.D. thesis. In either case, there is a specific faculty supervisor.

Holders of fellowships or the equivalent have no assigned duties other than continuation as full-time student taking four courses each semester. TA's and RA's are limited by the rules of the Graduate School to taking three courses each semester. External fellowships awarded in national competition require that the individual student apply. They are publicized by notices posted in the Department. Fellowships and the like within the University's jurisdiction are awarded by the Graduate School on the joint basis of Departmental nomination, decision by merit, and availability of funds. All assistantships cover the academic year only (September through May) or in some instances one semester only.

Fellowships, teaching assistantships and research assistantships provide for tuition sufficient to maintain standing as a full-time student (after all tuition requirements have been met, to cover the annual registration fee). In the first two categories, tuition is remitted. In addition to provisions for handling tuition, there is a nine-month stipend, which by present Departmental policy is the same for all categories of support.

There are differences as to academic progress that results from the differing categories of support. Obviously holders of fellowships or self-supported students can get through required course work faster than can assistants and so are earlier free to devote full time to research. On the other hand, TA's tend to orient themselves sooner with the Department, becoming acquainted with more students and faculty members. Consequently, they may begin earlier an acquaintance with research prospects. Holders of fellowships should strive to gain a similar early acquaintance. Research Assistants usually have the advantage of being paid for doing their own research, once it is started. There is no convincing evidence, however, that the total time to reach the Ph.D. depends appreciably upon the pattern of financial support. Ability, drive, previous preparation and sometimes a degree of luck are more important factors.

In keeping with a general aim for the fastest possible progress toward the Ph.D., consistent with good health and good work, graduate students are usually expected to work at Brown during the summer, if possible. The first summer can be a profitable period of assimilation, with some combination of preparation for qualifying examinations, teaching experience and research apprenticeship. In later summers the uncommitted time is invaluable for research. Students who go into research groups in the summer between their first and second year almost always receive summer support. Brown does not charge tuition in the summer.

H. FACILITIES

Many facilities and amenities are available, ranging from necessities of graduate work to things which simply make life agreeable. Those outside of Barus & Holley include the libraries, Graduate Center and recreational facilities, and extend to the life of the campus at large. They are most quickly discovered by a combination of exploration, conversation, attention to circulated notices and the weekly bulletin. A few of those closest to home are cited below. (Suggestions for additions to this listing are solicited, in the hope that it will become more useful as it grows.)

Extensive computer facilities are available, most associated with individual research groups. New students automatically receive an account on the Department's Windows server. Additionally, use of remote supercomputers can be arranged and extensive computer networks exist on campus with connections worldwide.

The Student (Machine) Shop is on the main floor of Prince Laboratory. It is under the supervision of Mr. Charles Vickers. (Previously, the shop staff offered an informal course for graduate students--not for academic credit and no tuition required--in the elements of machine shop skills. About a dozen physics graduate students enrolled, and several from other departments. This program is being continued on an ad hoc basis).

A small Departmental Research Library (Rm. 537) is available to all graduate students. A full collection of journals and books is available in the Science Library, and most collections are now online, accessible both to on and off campus computers.

A Reading Room (Rm. 202) is open to both undergraduate and graduate students during part of each day and in the evening. For access to Rms. 537 or 202, please see Barbara Dailey, Rm. 408.

Expert advice on a broad spectrum of research techniques is, of course, available for the asking in the various laboratories and offices in the building.

I. MISCELLANEOUS INFORMATION

Information about the research activities of specific groups or faculty members can be gained from many sources. The most obvious way is to ask an appropriate faculty member. It is equally desirable and useful to talk with students already engaged in research.

As additional background material, the authors and titles of Ph.D. theses for the past several years, with the faculty supervisors, are available from the Graduate Coordinator. Finally, the topical outlines of Physics core courses and other additional material can be found on the Physics Department web page: <http://www.physics.brown.edu>.

Fluency in English is an important skill for physicists. We urge (and may require) you to take advantage of the courses and assistance offered by the University and the International House.

APPENDIX: the Qualifying Examination

I. Composition and Duties of the Qualifying Committee

1. This Committee (Qualifying Prelim Committee, QPC hereinafter) shall comprise four faculty members appointed by the Departmental Chair to staggered two-year terms.

2. The QPC shall be chaired by a second-year member appointed by the Departmental Chair.

3. The QPC is empowered to solicit questions for the Qualifying Examination from faculty members (who are also expected to grade them) and, at their discretion, to formulate questions and delegate their grading to faculty members who are not on the QPC.

4. The QPC shall carry out such other duties connected with the Qualifying Examination as are specified in Departmental rules.

II. Rules Concerning the Qualifying Examination

A copy of the following rules shall be sent to each graduate student of Physics upon entering Brown University.

1. The purpose of the Qualifying Examination is to test whether a student has mastered core physics areas sufficiently well to carry out a successful Ph.D. program in Physics at Brown University.

2. Timing of the Qualifying Examination

(a) The Qualifying Examination will be scheduled near the first week of classes each autumn and spring semester.

(b) Students are ordinarily expected to take the exam at the beginning of their third semester. However, a student may request a postponement or ask to take the Examination earlier. The decision on such requests will be made by the Department Chair after consultation with the Advisor of Graduate Studies, and the student's research supervisor if there is one.

(c) A student who fails the exam must take it again at the next sitting or withdraw from the PhD program. In unusual circumstances, the Departmental Chair may allow postponement of this second sitting beyond the fourth semester. A student who has decided to leave after completing work for a Master's degree may take the Examination at the usual time, but upon request can be excused by the Departmental Chair.

(d) Normally, the graduate career in Physics at Brown University of any student failing the Examination twice will be terminated by the September following the second failure. However, in the event of two failures of the Examination a student may petition, in writing to the Departmental Chair, for a third chance at the next sitting of the Examination. The decision on this petition will be made by vote of the Departmental faculty, acting upon a recommendation made by an ad hoc committee consisting of the Departmental Chair, and the Advisor of Graduate Studies. Factors to be considered in reaching this decision are (i) the student's overall performance in courses, research and the previous Qualifying Examinations, (ii) timing of those Examinations, and (iii) comments of the research supervisor if there is one. A third failure will cause the

student's graduate career in Physics at Brown University to be terminated, not later than the next September following that failure.

3. Format of the Qualifying Examination

The qualifying examination is a written exam given on a single day. The exam will be based on material from the advanced undergraduate courses through material covered in the first year graduate core courses PHYS 2030, 2040, 2050, 2060, and 2140. Specifically, it will consist of pairs of problems in Classical Mechanics, Electricity and Magnetism, and Statistical Mechanics and Thermodynamics, and two pairs of problems in Quantum Mechanics. A student may answer one of each pair of the problems, and thus may submit answers to a total of 5 problems. Each problem is graded out of 10, with 6 considered a passing grade. A student who obtains a grade of 6 or greater on every problem passes outright. Otherwise, each student's case will be considered individually by the full faculty.

Suggested texts:

Classical Mechanics and the Special Theory of Relativity

Becker; Fetter and Walecka; Fowles and Cassiday; Marion and Thornton; Symon

Electricity and Magnetism

Griffiths; Jackson; Lorrain, Corson and Lorrain; Reitz, Milford and Christy

Statistical Physics

Huang; Kittel and Kroemer; Reif

Quantum Mechanics

Baym; Gasiorowicz; Griffiths; Liboff; Merzbacher; Park; Sakurai; Shankar

4. Faculty Evaluation of the Examination Results

Decisions on whether individual students have passed the Qualifying Exam and will or will not be admitted to candidacy for the Ph.D. degree will be rendered by the Faculty soon after completion of the exams.

The Faculty may also, if it deems appropriate, instruct the Departmental Chair to take steps concerning the future graduate career in Physics at Brown of any student whose status is under review. Such steps may include the requirements that additional courses be taken, or that an M.Sc. thesis be written, or that financial aid be discontinued.

5. Availability of Examination Results

As soon as possible after tabulation of the results, students shall be notified of their grades on the individual written Examination questions.

Students shall be afforded the opportunity to inspect their graded booklets.

Students may submit comments on the exam or its grading to the QPC for their review.

6. Notification of Examination Details

The QPC will set, prior to each exam, the specific timetable for the exams, their grading, the availability of booklets and the Department Faculty Meeting. Students taking the exam will be notified well in advance of this timetable as well as of all other relevant details such as where and when the graded booklets will be available, and the specific details as to their inspection.

7. Eligibility for Examination

Ordinarily only graduate students registered in the Department of Physics may take the Qualifying Examination. Other students who wish to take the Examination may do so at the discretion of the Chair of the Department of Physics.

8. Review of Procedures II-1 through II-7

Annual reviews and revisions of all these procedures may be undertaken in succeeding years when the need appears, provided that prompt written notice of any changes is given to all graduate students affected.

BROWN UNIVERSITY MEMORANDUM

March 2003

To: Physics Faculty and Graduate Students
 From: The Qualifying/Prelim Exam Committee
 Subject: Texts Relevant to the Qualifying Exam

In Jan.2003, the Physics Faculty adopted a new format for the Qualifying Exam. The questions in the examination will be based on the prescribed core courses for the Ph.D. requirement (except for the laboratory course). The intent of this exam is to test for understanding and knowledge over a broad range of topics. Consequently, the best preparation is a comprehensive review including reading and problem solving. Every effort is made to make this exam fair and at the appropriate level of difficulty. However, the questions will not necessarily be related to those given in previous exams or to questions or problems in textbooks.

As a guide to a wide range of the material that should be mastered, we provide the following list of books. An effort will be made to make these books available by having them placed on reserve in the Sciences Library.

Recommended Texts

Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles
 by Eisberg and Resnick
 The Structure of Matter by Gasiorowicz
 Thermal Physics by Kittel and Kroemer
 Statistical and Thermal Physics by Reif
 Modern Physics, 3rd Edition by Sproull and Phillips
 Theoretical mechanics of Particles and Continua by Fetter and Walecka
 Classical Mechanics, 2nd Edition by Goldstein
 Classical Electrodynamics by Jackson
 Lectures on Quantum Mechanics by Baym
 Quantum Mechanics by Merzbacher
 Quantum Mechanics by Schiff
 Modern Quantum Mechanics by Sakurai

Other material (at the same levels) should also be consulted. A sample of texts that we use or have used over the last several years and could be relevant follows:

Analytical Mechanics by Fowles and Cassiday
 An Introduction to Thermal Physics by D. Schroeder
 Classical Dynamics of Particle & Systems by Marion
 Classical Electrodynamics by J.D. Jackson
 Div. Grad, Curl & All That, 3rd Edition by M. Schey

Electricity of Magnetism, 2nd by E. Purcell
Foundations of Electromagnetic Theory by Reitz, Milford Christy
Fundamentals of Physics 5th Edition by Halliday/Resnick & Walker
Fundamentals of Statistical and Thermal Physics by Reif
Intro. To Concepts & Theory in Physical Science 2nd 85 by G. Holton & S. Brush
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