Texas Tech Physics Graduate Booklet

Issued September 2016

This booklet will apply to students who enter fall 2016 or later. Students who entered before fall 2016 may use the rules in this booklet or in any previous booklet.

1 Degree requirements

Core requirements for all programs:
Phys 5301: Quantum Mechanics
Phys 5303: Electromagnetic Theory
Phys 5305: Statistical Physics
Phys 5306: Classical Dynamics
Phys 5101: Seminar (three of the first four semesters a student is enrolled)

Course replacements:

For the applied physics master's concentration, one of these courses may be replaced with a course from the student's applied area. At the discretion of the graduate advisor, one additional course may be replaced with a course that covers substantially similar material in a manner more applicable to the student's interests (e.g. an electromagnetism course from electrical engineering or a classical mechanics course from mechanical engineering or a quantum mechanics course in physical chemistry). Any further replacement of core courses must be approved by graduate advisor in consultation with with graduate program committee.

For the thesis-based master's degree programs only, students may take bridging or levelling courses instead of the standard core course equivalent.

Additional core requirements for doctoral programs:
Phys 5302: Quantum Mechanics II
Phys 6306: Advanced Electromagnetic Theory

Tools courses
Students will benefit strongly from taking PHYS 5307 (Methods in Physics), which is a math methods course, in their first semesters. This course is not formally required, but except for students who enter with an especially strong mathematical background, it may be difficult to do the core coursework at a satisfactory level without taking the math methods course. Many students will also benefit from taking PHYS 5322 (Computational Physics) and PHYS 5323 (Advanced Data Analysis) early in their studies.

Option courses:
Most students will need to take additional coursework beyond the minimum

requirements in order to develop the necessary expertise for their thesis research. This coursework should be defined by the student with advice and consent of the research advisor and of the thesis committee.

1.1 Minimum requirements for specific degree programs

1. **M.S. in Physics, thesis option:** 30 credit hours, including 6 credit hours of PHYS 6000 (Master's Thesis), plus an oral defense of the thesis.

2. **M.S. in Physics, thesis option, applied concentration:** 30 credit hours, including 6 credit hours of PHYS 6000 (Master's Thesis), plus an oral defense of the thesis. At least 9 credit hours must be formal courses in a specified applied area (which may include a sub-field of physics, or courses from another department on campus). The thesis must be in the applied field.

3. **M.S. in Physics, non-thesis option:** 36 credit hours, of which at least 24 must be in the department. Waivers of the requirement that 24 credit hours be in the department may be obtained at the discretion of the graduate advisor if there is strong justification. Students must additionally complete a master's comprehensive exam.

4. **Ph.D. in Physics:** Minimum of 72 credit hours beyond the bachelor's degree, including at least 12 hours of PHYS 8000 (doctoral dissertation). To be admitted to candidacy, students must pass the preliminary qualifying exam and a proposal defense. To be awarded the Ph.D. students must pass a Ph.D. dissertation defense.

1.2 The master's comprehensive exam

The requirement for a master's comprehensive exam can be satisfied either by passing the prelim for the Ph.D. program, or by passing an oral exam on fundamental physics. Students must notify the graduate advisor if they wish to take the oral exam one semester prior to the anticipated graduation date.

1.3 Other requirements

1. **GPA requirements:** Students must have a GPA of at least 3.0 both overall, and in the core courses, in order to earn either an M.S. or Ph.D.. Students in the M.S., applied physics concentration may have a GPA of 3.0 in only the core courses being used to satisfy the degree requirements. Independent study courses will not be included in GPA calculations for determining whether the student has on overall GPA of at least 3.0.

2. **Levelling courses:** Students with insufficient undergraduate preparation, or who completed their undergraduate degrees a substantial length of time before enrolling, should consult with the graduate advisor about whether to take upper-level undergraduate courses, or specially designed graduate courses. These courses must be passed with a grade of at least a B, and failure to earn grades of at least B in such courses will result in immediate academic suspension.

3. **General university-wide requirements** Graduate students in the department are expected to meet all university requirements for academic integrity, full time enrollment status and residency for earning degrees.

2 Other obligations and expectations of students

1. Students must take responsibility for filing degree plans and Intent to Graduate forms on time. Students planning to earn a Ph.D. must file degree plans for both the M.S. and Ph.D.. Forms and dates should be obtained from the Graduate School web site.

2. Students must file a Review of Student Progress form every semester. This should include a statement from the research advisor about the progress the student has made on research and, if the student is funded as a teaching assistant, a report on the student's performance as a teaching assistant from the appropriate lab director or instructor. Students who have been admitted to candidacy for the Ph.D. must also meet with their Ph.D. committees at least once per year to discuss their progress.

   If the student's performance is found by the thesis committee to be unsatisfactory, the student will be required to re-appear before their committee within six months to show that they have rectified the performance issues. If the student's performance is still deemed to be inadequate, the student will be required to leave the program. Under some circumstances, the student may appeal this decision to an appeals committee made up of the members of the graduate program committee who are not members of the student's thesis committee, plus additional faculty members to be appointed by the department chair if the appeals committee would otherwise have fewer than five members.

3. Students are expected to register for classes in advance in order to ensure that courses have the minimum of 5 students registered in advance.

4. Students must promptly file forms with the Graduate School if changing their degree programs.

3 Research, thesis and independent study courses

Students will often end up taking a large fraction of their credit hours in unstructured courses. A few guidelines are thus helpful for students and for faculty in terms of expectations for these courses. It is expected in all cases that students will consult with possible faculty mentors before signing up for independent study or seminar courses.

3.1 Independent study

Independent study should normally be used for cases where a student wishes to develop an understanding of the type of material that might make up a scheduled course during a semester when the course in question is not being offered. Students in independent study courses should expect to do a substantial amount of reading, work homework-type problems, and perhaps to take a test on the course material. Only under exceptional circumstances should independent study courses take the place of the standard core courses.

3.2 Research and thesis courses

Research and thesis courses should be composed of some combination of reading literature, attending group meetings, doing calculations and simulations, doing experiments, and preparing results for publication and presentation. While some background reading is appropriate, the focus of a research course should be on taking steps toward original scientific discoveries. Students should expect to spend a total of at least three hours per week working on the research project for every credit hour they take. Students spending significantly less than this amount should not expect to earn good grades for these courses.

4 Teaching assistant support

The letter detailing the offer of admission to a student will indicate the duration and form of financial support for the student. For most incoming graduate students, there will be guaranteed support for a minimum of two semesters as a teaching assistant, contingent upon satisfactory performance both as a teaching assistant and in academic coursework. Continued support can normally be expected contingent on satisfactory performance as a teaching assistant and satisfactory progress toward a Ph.D..

Students needing teaching assistant support are expected to notify the Director of Teaching Laboratories by the deadline each semester, or they will risk not being funded.

Students who do not meet expected timescales for completing the master's degree requirements (normally within two years of entry), passing the preliminary qualifying exam (normally within 2 years of entry), passing the thesis proposal (normally within three years of admission) or completing the Ph.D. thesis (normally within 6 years of entry) will be placed at low priority for teaching assistant positions unless there are extenuating circumstances which are clearly laid out.

International graduate students may be funded as graders for 2 semesters if they fail to pass the international TA workshops prior to starting teaching. Only in exceptional circumstances will students who continue not to pass the TA workshops be funded as graders.

5 Expected timescales for reaching key milestones

1. For research degrees, an advisor should be selected by the end of the first year. Changes of research advisors must be approved by the graduate advisor, especially if they are made after passing the prelim exam.

2. Completion of master's degrees should ordinarily be done within two years. A third year may be allowed for students who need to take substantial numbers of levelling classes.

3. Passage of the preliminary exam should ordinarily be done within two years. Students who are admitted with a need to take undergraduate

material may be allowed to take their attempts at the prelim at the ends of their second and third years, provided that they have already been awarded a master's degree with thesis by the time they take their second attempt at the prelim.

4. The Ph.D. thesis proposal should be done within one year of the later of passing the prelim and completing sufficient coursework to qualify for a master's degree. The graduate advisor may authorize an extension on this timescale where appropriate. Further extensions will require a detailed explanation of the circumstances, and approval of the graduate program committee.

5. The Ph.D. thesis should be completed within 6 years of starting the program. Extensions of this timescale may be obtained with permission of the student's thesis committee and the graduate program committee. To obtain an extension, students should demonstrate that substantial progress has been made, and that there were unforeseen barriers to progress that have prevented completion within the 6-year timeframe.

6 Direct admission to the Ph.D. program: procedures for admission and policies for students

Texas Tech welcomes the applications of students who are ready to begin working on their Ph.D. theses immediately.

Students may be admitted directly to the Ph.D. program if they meet the following circumstances:

1. A master's degree (or equivalent) with thesis in physics or a closely related subject.

2. At least one research result deemed worthy of publication in a major journal. If there is no paper yet published, the applicant may send a paper draft to the department for evaluation. The student may be a co-author on the paper provided that there is a declaration from the lead author of the nature of the student's involvement in the work, and it constitutes a substantial contribution indicating that the student is well-prepared for Ph.D. level research.

3. A declaration from the student's master's institution that the student has not failed a Ph.D. qualifying exam.

4. One of the following additional criteria must be met:
   Passage of an interview with a committee of at least three faculty members. The interview will consist both of evaluation of the student's potential for research and questions of a similar nature and difficulty level as the questions on the oral part of the preliminary qualifying exam. Because of the need for time to organize the interview committee, student applying via this process should apply early.
   OR The student has already been admitted to candidacy at another university, and the other university's procedures and standards for admission to candidacy are deemed to be substantially similar to Texas Tech's.
   OR The student has completed the master's degree at an institution with a comprehensive exam in physics as a graduation requirement, and that exam is deemed to have standards substantially similar to Texas Tech's preliminary qualifying exam.

Students who are admitted directly into the Ph.D. program must pass the thesis proposal within one year of arrival at Texas Tech, and should ordinarily complete the Ph.D. within four years of arrival (with extensions possible for unusual circumstances). The requirement of 72 total credit hours is unchanged from the standard degree requirements, but formal coursework requirements will be determined by the student's advisor in addition with the graduate program committee on a case-by-case basis.

Students who apply for direct entry to the Ph.D. program, but who do not meet all of the requirements may still be admitted to the standard M.S./Ph.D. program.

7 Admittance to Ph.D. Candidacy

Qualification for candidacy for the Ph.D. consists of two examinations: the preliminary exam, and the thesis proposal.

7.1 The preliminary exam (prelim)

The preliminary exam will be a test of classical mechanics, quantum mechanics, electricity and magnetism, and general physics at a level consistent with both solid undergraduate preparation and the core courses in the department.

The exam will be offered shortly before the start of classes each autumn, and also in January if five or more students wish to take it then. It will consist of two half-days of written examination and one hour of oral examination for each student. The written component will count as 2/3 of the grade, and the oral exam will count as 1/3 of the grade. There will be two graders for each question on the written exam, and if the graders differ by more than 25 points out of 100, then a third grader will be assigned. There will be at least five examiners for the oral exam.

7.2 The Ph.D. thesis proposal

Qualification for candidates for the Ph.D. consists of two stages, a presentation of research done to date, and a presentation of a thesis proposal. At each stage, the student's research committee may make the determination that the student has passed, has failed, or must re-appear before the committee. Students may also be passed conditionally, if the committee is generally satisfied with the student's performance, but believes that some specific improvements are needed (e.g. if a student needs to take additional coursework to gain technical competency to complete the thesis, this may be required by the committee).

7.2.1 Proposal defense

The student must lay out what he/she plans to do for his/her Ph.D. thesis in a report of no more than 15 pages. He or she must then meet with his/her thesis committee and demonstrate sufficient background and technical competence to ensure the committee that the thesis is likely to produce substantial scientific results, and that the student is capable of completing

the work. This meeting will consist of a presentation of about 20 minutes followed by questions from the committee. The committee may return a finding that the proposal is acceptable, unacceptable, or in need of revision. If the proposal is found unacceptable, the student will not be admitted to candidacy. If the proposal is need of revision, a new proposal defense should be scheduled within 6 months.

8 Thesis committees

A master's thesis committee shall consist of the student's research advisor and at least two other faculty members.

A Ph.D. thesis committee shall consist of at least three faculty members from the department of physics. The committee will often include at least one faculty member from the university from another department and at least one additional person from outside the university.

9 Exceptions to the general regulations of the department

Students who have been notified of suspension of their degree programs, termination of their degree programs, or ineligibility for funding will have the opportunity to appeal. Appeals will first go to the graduate advisor. If the appeal is denied by the graduate advisor, it will then be taken to the full graduate program committee. The graduate advisor will not vote at the proceedings of the graduate program committee. If the graduate program committee also denies the appeal, then no further appeals will be allowed within the department.