

# GRADUATE BOOKLET

## Physics / Applied Physics

This booklet contains rules, guidelines and general information about graduate studies in the Physics Department at Texas Tech University. It does not replace the graduate catalog, and students are responsible for following detailed procedures as outlined in official documents.

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***September 2011***

This document replaces the previous versions of the Graduate Booklet.

Each graduate student is subject to the rules in the Graduate Booklet which was in effect at the time (s)he joined the graduate program at TTU. A student may elect to use the rules in a later version of the Graduate Booklet, but not an earlier version.

## I. GENERAL COMMENTS

**1. Admission Standards:** In addition to the general Graduate Record Examination (GRE) required by the Graduate School, the Physics Department requires every prospective graduate student to take the Advanced GRE in Physics. If a student is recruited prior to taking the Physics GRE, (s)he may be *conditionally* admitted but must take this exam not later than six (6) months after coming to TTU.

**2. Registration / Classification:** Incoming PhD students should be admitted into both the MS and PhD programs until they pass the Preliminary Exam, unless they already have an MS degree in Physics.

**3. Leveling Courses:** Based on transcripts, GRE scores, and an interview, the Graduate Advisor may recommend leveling courses in any of the four PhD core areas: Quantum Mechanics, Electromagnetic Theory, Classical Dynamics, and Statistical Mechanics. Graduate students are expected to pass leveling courses with a grade of B or better.

**4. Full-time Enrollment:** The University requirement for full-time enrollment in a regular semester is 9 hours and 3 hours in one summer term. PhD students nearing the end of their Ph.D. may register for less than 9 hours in accordance with Graduate School rules. Enrollment in more than 13 hours per long semester or more than 6 hours per summer term requires approval from the Graduate School.

**5. Partial Tuition & Fee waiver:** Teaching Assistants (TAs) and Research Assistants (RAs) on 50% appointment and students on a scholarship (annual minimum: \$1,000) may have out-of-state tuition waived. A portion of the in-state tuition and fees may also be waived. The waiver form (available from the departmental office) must be completed and signed by the Chair.

**6. International TAs:** Students who wish to become a TA must successfully complete the TA workshop which is offered each August. They may be required to enroll in the appropriate English course(s) and perform satisfactorily in the following semester. If a student fails the first TA workshop, his/her financial support may be substantially reduced. The student will be re-evaluated at the end of the semester. No improvement will jeopardize financial assistance.

**7. Residence Requirements:** A one year residency is required by the University; consult the Graduate Catalog for details.

**8. Transfer Credit:** Students entering with an MS or MA degree from another university will have their records examined by the Graduate Advisor for transfer of credit. The University and accrediting agency limits the number of hours that can be transferred.

**9. Minimum Grade Point Average (GPA):** Graduate students must maintain an overall GPA of 3.0. A student is placed on *probation* if their GPA falls below 3.0 in any given semester. The student is *suspended* if their GPA remains below 3.0 after the following semester (see the Graduate Catalog and OP 64.04 for details). To obtain the MS or PhD degree, the overall GPA must be at least 3.0.

**10. Deadlines:** Degree candidates are responsible for observing Graduate School deadlines for filing required forms, taking final examinations, and submitting theses or dissertations. The deadlines are listed for each semester on the University website.

**11. Assignment of Research Advisor:** Students pursuing a graduate degree in physics are strongly encouraged to associate with a Research Advisor as early as possible, are to be engaged in research before the start of their second year. Research students should take PHYS 7000 (Graduate Research) in the section assigned to their Advisor. A student may change Research Advisors upon consultation with the Graduate Advisor and their current Advisor.

**12. Plagiarism** in research papers or reports as well as any course-related work is serious academic misconduct. *This violation includes, but is not limited to, the use by paraphrase or direct quotation of the published or unpublished work of another person without full and clear acknowledgment. It also includes the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.*

## II. MINIMUM DEGREE REQUIREMENTS

- 1. MS in Physics, thesis option:** Minimum 24 hours of course credit with a minimum of 18 hours in the department, plus 6 hours of thesis credit. A Master's Thesis on a research problem and a final oral defense are required.
- 2. MS in Physics, non-thesis option:** Minimum 36 hours of course credit with at least 24 hours in the department, plus passing the Master's Comprehensive Examination.
- 3. MS in Applied Physics, thesis option:** Minimum 24 hours of course credit with a minimum of 9 hours in a specified applied area (sub field of physics or related discipline), plus 6 hours of thesis credit. A Master's thesis in the applied area, and a final oral defense are required.
- 4. MS in Applied Physics, internship option (MS-I):** 36 credit hours, of which 12 are related to the internship and MS Report. Design of an applied program of study, including specifics of the 24 hours of course credits, are to be specified in consultation with the MS Internship Advisor.
- 5. MS in Applied Physics, non-thesis option:** 36 credit hours with 15 in a specific applied area, an MS Report (or work submitted for publication), plus passing the Master's Comprehensive Examination.
- 6. PhD in Physics:** Minimum of 60 hours of course credit beyond the Bachelor's Degree or equivalent, including research credits. At least 39 of these hours should be formal courses (PHYS 53xx, 63xx, etc). With approval of the Research and Graduate Advisors, up to 12 of these hours may be taken outside the department. In addition, 12 Dissertation hours (Phys 8000) are required. The Preliminary Exam and the Proposal Defense must be passed to qualify for the PhD. After successfully defending the Proposal, a student is officially a PhD Candidate, and the PhD Dissertation Defense must be completed within four (4) years.
- 7. PhD in Physics, Applied Physics Option:** Same as §5, except that the content of the curriculum needs to be worked out between the student and Research Advisor, in consultation with the student's PhD Committee and the Graduate Advisor. Courses must include 15 hours within a designated applied area and listed as a Minor in the degree plan. The PhD committee must include a Graduate Faculty member from the Minor area. The student is tested over the Minor area as part of the PhD Qualifying process if outside of Physics, and can elect to have the Minor designated on their transcript.

## III. REQUIRED PAPERWORK

### A. Degree Plans

- 1. Master's Degree Plan:** Graduate School rules state that an MS Degree Plan should be filed with the Graduate School within the first semester a student is in a degree program, There are very strict deadlines for filing a degree plan that fall more than a semester before of any proposed graduation date. The appropriate form, '*Program for the Master's Degree and Admission to Candidacy*' is available online from the Graduate School site. The major, a minimum set of courses to be taken, any credits being transferred, the degree option to be used, and (for Thesis option) the MS Committee and Thesis Title (if known) are listed on this form. The MS Degree Plan must be approved by the Graduate Advisor, in consultation with a student's Research Advisor if applicable, before submission to the Graduate School. The details on the MS Plan are used in performing a degree audit immediately prior to awarding of an MS degree. This form should be filed early; it can easily be modify later if required.
- 2. Doctoral Degree Plan:** The PhD Degree Plan should be filed after passing the Preliminary Exam and must be on file with the Graduate School before the PhD Proposal is presented to the student's PhD Committee. The form '*Doctoral Proposal and Report of Preliminary Examination*' is available from the Graduate School's website. It lists a minimum set of courses, the PhD Committee and PhD research topic or Dissertation Title, if known. Details are used in performing a degree audit prior to awarding a PhD degree. Any changes are to be filed before the semester in which a student anticipates completion of their degree requirements.

## **B. Performance Evaluations**

**A Review of Student Progress** is undertaken by the department every semester. All graduate students are required to update their progress once each semester, and to meet with the Graduate Advisor before registering for the following semester. An official review of a PhD student's progress toward meeting degree requirements is mandated by the Graduate School after three years and every year thereafter. If progress is deemed to be unsatisfactory for two successive periods, the student may be terminated by the Graduate School. The report should contain a statement from the student's Research Advisor regarding research performance and progress, a report from the Lab Director regarding performance as a TA and a summary of student evaluations if applicable, and any other material deemed relevant. PhD Candidates are strongly encouraged to meet with their PhD Committees as part of this annual review process.

## **C. Change of Graduate Program**

**A Change of Graduate Program** form is required if a student chooses to change their graduate major even if within the same department; for instance, a change from Applied Physics to Physics. This form is available online. This form is also used to change from the MS to PhD program, or to obtain an MS degree after being classified as a PhD student by the Graduate School. Admission to both MS and PhD programs initially should minimize this paperwork.

## **D. Intent to Graduate**

**An Intent to Graduate** form must be filed with the Graduate School at the beginning of any semester that a student anticipates the possibility of obtaining a graduate degree. Deadlines vary from one semester to another and are available well in advance. This form must be re-filed each semester. The forms are available online and are different depending on the degree option. An official Thesis or Dissertation Title and signature of the Research Advisor are required for research based degrees.

# **IV. PRIORITIES AND SEQUENCING**

## **A. PhD students**

- \* register initially as an MS/PhD student if entering from a BS/BA
- \* take the core and tools courses
- \* submit a MS Degree Plan to the Graduate School by the end of the 1<sup>st</sup> semester
- \* select a Research Advisor during the first academic year
- \* take the PhD Preliminary Exam when first offered following 2 long semesters
- \* select a PhD Committee and file a PhD Degree Plan
- \* prepare and defend a PhD Research Proposal *within one year* of passing the Prelim.
- \* the PhD Prelim plus the Proposal Defense constitute qualifying for PhD Candidacy.

## **B. MS students**

- \* take the core and tools courses
- \* file a MS Degree Plan with the Graduate School by the end of the 1<sup>st</sup> semester.

### ***Thesis option:***

- \* select a Research Advisor and a MS Committee
- \* become active in research as early as possible
- \* prepare and defend an MS thesis.

### ***Non-Thesis option:***

- \* take the MS Comprehensive Exam (PhD Prelim) at the first opportunity after 2 long semesters.

## **C. MS - Internship students**

- \* define applied program and file MS degree plan during 1<sup>st</sup> semester
- \* complete six courses from degree plan
- \* complete an internship (minimum of 6 months)
- \* finish required courses
- \* prepare and present the MS Report.

## V. COURSES AND SCHEDULING

**1. Advance registration:** No graduate course can be taught unless at least 5 graduate students are registered in it. In order to avoid last minute cancellations, the Physics Department requires continuing graduate students to meet with the Graduate Advisor and to complete their registration early. Students will be advised by the Graduate Advisor if some courses have to be dropped or consolidated.

**2. General:** All TAs are expected to take **PHYS 5374** (Pedagogy in Physics) in their first semester as a TA, or when first offered. Full-time graduate students must take **PHYS 5101** (Seminar, P/F) three (3) times during their first four (4) semesters at TTU. All graduate students are expected to regularly attend the Departmental Colloquium (Seminar) even when not officially enrolled in this course.

**3. Core courses:** For the MS and PhD degrees in Physics, students must pass the following 'essential core courses' with a minimum 3.0 GPA overall average. A course may be re-taken one time to satisfy this requirement. The four core courses are:

<b>PHYS 5301</b>	<b>Quantum Mechanics I</b>	<b>PHYS 5303</b>	<b>Electromagnetic Theory</b>
<b>PHYS 5305</b>	<b>Statistical Physics</b>	<b>PHYS 5306</b>	<b>Classical Dynamics</b>

All PhD candidates also must take

<b>PHYS 5302</b>	<b>Quantum Mechanics II</b>	<b>PHYS 6306</b>	<b>Advanced Electromagnetic Theory</b>
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**4. Tools courses:** These 'tools courses' should be taken as soon as possible for maximum benefit:

<b>PHYS 5307</b>	<b>Methods in Physics</b>	<b>PHYS 5322</b>	<b>Computational Physics</b>
		<b>PHYS 5323</b>	<b>Advanced data Analysis</b>

**5. Specialized courses:** All MS students normally take at least two and all PhD students at least four of the following:

<b>PHYS 5304</b>	<b>Solid State Physics</b>
<b>PHYS 5308</b>	<b>Molecular Biophysics</b>
<b>PHYS 5310</b>	<b>Quantum Field Theory</b>
<b>PHYS 5311</b>	<b>Nuclear Physics</b>
<b>PHYS 5312</b>	<b>Elementary Particle Physics</b>
<b>PHYS 5335</b>	<b>Physics of Semiconductors</b>
<b>PHYS 5336</b>	<b>Device Physics</b>
<b>PHYS 5338</b>	<b>Nano-Photonics</b>
<b>PHYS 6301</b>	<b>Advanced Quantum Mechanics</b>
<b>PHYS 6304</b>	<b>Condensed Matter Theory</b> (currently 7304)
<b>PHYS 6305</b>	<b>Statistical Mechanics II: Critical Phenomena</b>
<b>PHYS 5300</b>	<b>Special Topics</b>

**At least two topical courses outside a student's research area are required for the Physics PhD.**

Special Topics may include: Group Theory, Laser Physics, Quantum Optics, Atomic and Molecular Physics, Molecular Spectroscopy, Optoelectronics, Plasma Physics, Surface Physics, and others. More than one PHYS 5300 course may be taught during the same semester. The student should request that the grade transcript show the particular course title.

**Example:** a PhD curriculum in condensed matter physics (as listed on the PhD Plan) might be: 5301, 5302, 5303, 5304, 5305, 5306, 5307, 5309, 5312, 5322, 6306, 6304, 6 hrs 5300, 3 hrs 5101, 15 hrs 7000, plus 12 hrs 8000.

**6. Research courses:**

<b>PHYS 6000</b>	<b>Master's Thesis</b> (6 hrs total required for a Thesis MS)
<b>PHYS 7000</b>	<b>Research</b>
<b>PHYS 8000</b>	<b>Doctor's Dissertation</b> (12 hrs total required for a PhD)

PHYS 7000 gets a letter grade but PHYS 6000 and 8000 are assigned the grade CR (credit) until the semester in which the Thesis or Dissertation is completed. Then, a standard letter grade is assigned. PhD students must accumulate 30 credit hours and become a PhD Candidate before being allowed to sign up for PHYS 8000. Until then, they may sign up for PHYS 7000.

**7. Courses for MS Internship students:** An MS-I program can be designed in any area of applied physics, with specific course designated to make up the applied emphasis area. The following credits are required in any internship based MS degree:

**PHYS 5001** *Master's Internship in Applied Physics (9 hours minimum)*

**PHYS 6002** *Master's Report (3 hours minimum)*

As an example of designated courses with an applied emphasis, five of the following courses are typically included in a semiconductor emphasis:

**PHYS 5301** *Quantum Mechanics*

**PHYS 5322** *Computational Physics*

**PHYS 5330** *Semiconductor Materials and Processing*

**PHYS 5332** *Semiconductor Characterization and Processing Laboratory*

**PHYS 5335** *Physics of Semiconductors*

**PHYS 5336** *Device Physics*

**8. First two-semester schedule:** Unless leveling courses are needed, we recommend the following for students arriving in the fall of 2009 **(all students must consult with the Graduate Advisor):**

**Fall '09:**

**5374** *Pedagogy in Physics*

**5301** *Quantum Mechanics I*

**5306** *Classical Dynamics*

**5307** *Methods in Physics*

**Spring '10:**

**5101** *Seminar*

**5303** *Electromagnetic Theory*

**5305** *Statistical Physics*

**5302** *Quantum Mechanics II*

**9. Tentative Schedule:** PHYS 5001, 5101, 5104, 6000, 6002, 7000, and 8000 are offered every semester. Core and tools courses are normally offered every spring or fall. Courses typically offered every second spring or fall are denoted with an \*. More than one 5300 course may be offered during any given semester, but a particular topic taught as a 5300 course may be offered only occasionally. Please, check which 5300 courses are offered in each semester.

**Fall, even years**

**5300** *Special Topic*

**5301** *Quantum Mechanics I*

**5306** *Classical Dynamics*

**5307** *Math Methods in Physics*

**5374** *Pedagogy in Physics*

**5335** *\*Physics of Semiconductors*

**6306** *Advanced Electromagnetic Theory*

**6305** *\*Statistical Mechanics II*

**Spring, odd years**

**5300** *Special Topic*

**5302** *Quantum Mechanics II*

**5303** *Electromagnetic Theory*

**5305** *Statistical Physics*

**5311** *\*Nuclear Physics*

**6312** *\*Quantum Field Theory*

**5336** *\*Device Physics*

**5309** *\*Methods in Biophysics*

**5338** *\*Nano-Photonics*

**Fall, odd years**

**5300** *Special Topic*

**5301** *Quantum Mechanics I*

**5306** *Classical Dynamics*

**5307** *Math Methods in Physics*

**5374** *Physics Pedagogy*

**6306** *Advanced Electromagnetic Theory*

**5304** *\*Solid State Physics*

**6309** *\*Advanced Quantum Mechanics*

**Spring, even years**

**5300** *Special Topic*

**5302** *Quantum Mechanics II*

**5303** *Electromagnetic Theory*

**5305** *Statistical Physics*

**5322** *\*Computational Physics*

**5312** *\*Elementary Particle Physics*

**5308** *\*Molecular Biophysics*

**6304** *\*Condensed Matter Physics*

Students should consult the list of specific courses offered each semester as this schedule may have to be modified, and special topics are offered whenever a professor chooses to make such courses available.

## VI. MILESTONES

### 1. Selection of a Thesis or Dissertation Advisor and Research Committee

- \* The first major step a student takes toward a research based MS or PhD is to select the area of their research and choose a Research Advisor. This should be done as early as possible, but not later than the end of a student's first academic year. Students should meet with several faculty who work in areas of their interest prior to making this decision to discuss what project options may be available.
- \* The first summer, or semester, is often considered as a trial period during which both the student and advisor should determine whether the relationship should continue toward a MS or PhD degree project.
- \* Soon after initiating research toward a degree the Research Committee should be named. The student should meet with each potential committee member to make sure they are willing to serve. Any committee should be approved by both the student and primary Advisor. MS Committees consist of a minimum of two Graduate Faculty members with at least one from Physics. PhD Committees consist of a minimum of four Graduate Faculty members with at least three directly associated with Physics. PhD Committees should be chosen prior to filing the PhD Degree Plan.

### 2. The PhD Preliminary Exam / Masters Comprehensive Exam

- \* This pass/fail examination is required by the Graduate School and constitutes official acceptance into the PhD program in Physics. Its purpose is to test understanding of physics and potential for PhD research. This exam also serves as the Comprehensive Exam for the MS degree, non-thesis option.
- \* The Prelim covers general physics and the four PhD core courses. The major areas are: General Physics, Classical Dynamics, Quantum Mechanics, Electromagnetic Theory, and Statistical Physics.
- \* The Prelim can be taken at most twice, on consecutive occasions. Failing on the second attempt will result in the student being dropped from the PhD program in Physics.
- \* A separate decision is made with respect to the MS Comprehensive Exam. A candidate must declare for MS consideration prior to taking the exam.
- \* The Prelim is currently offered once a year and timing is advertized well in advance. A student who enters the program intending to pursue a PhD must take the Prelim when it is first offered after being in the program for two regular semesters. A student arriving with an MS degree who transfers credit for all of the core courses should take the Prelim at the earliest opportunity. A candidate who does not take the Prelim within the above time frame is considered to have failed that attempt. Any exception to this schedule must be approved in advance by the Graduate Advisor.
- \* The Chairman of the Prelim Committee submits a report to the Departmental Chair and Graduate Faculty, and officially notifies in writing the Candidates and Graduate Advisor of the outcome (P/F).

### 3. The PhD Research Proposal

- \* The deadline for this final PhD Qualifying step is one year after passing the Prelim or meeting the minimum criteria for an MS degree, whichever is later. A student's Research Advisor may request an extension in writing to the Graduate Advisor providing an appropriate justification for a delay.
- \* The candidate writes a Research Proposal covering the PhD project and defends it orally before the PhD Committee. The Proposal should be less than 15 (typed) pages, including references, figures, and tables. It should outline work already accomplished as well as present details of the proposed project.
- \* The intent of the PhD Proposal is to demonstrate that the candidate understands the relevant scientific background, how the proposed research fits into the general field, and has original ideas for research to expand the 'state-of-the-art', bring in new information, or provide an original perspective on the central problem. An adequate search of the relevant literature is expected.
- \* The written research proposal must first be approved by the Research Advisor, and then submitted to each Committee member not less than ten (10) days before the date of the presentation.
- \* The oral presentation by the candidate (typically 30-40 minutes) is followed by questions from the Committee. Immediately following the presentation, the Committee deliberates and decides whether the candidate has successfully defended the proposal. If not, at the discretion the committee, the candidate may repeat the defense one additional time within one semester.

\* The Research Advisor notifies the Graduate Advisor in writing that the student has successfully defended the Research Proposal. The Graduate Advisor then notifies the Graduate School that the candidate successfully passed the PhD Qualifying Examination and is officially a PhD candidate.

### **3. Thesis and Dissertation Defense:**

\* After completing the research and writing the thesis or dissertation, the candidate makes a public oral defense of his/her research before the Advisory Committee, an official delegate from the Graduate School (for PhD dissertations), and other interested persons. This defense is a formal occasion which should be attended by the faculty and graduate students.

\* The Graduate School requires that the defense be scheduled at least *three weeks* before the deadline for the submission of the manuscript to the Graduate School. (See the TTU Academic Calendar.)

\* The candidate must provide every member of his/her Committee with a copy of the thesis or dissertation at least two weeks before the defense. Although this copy need not be a final version, it must have been approved by the candidate's Research Advisor.

\* The Defense *must* be announced to the Physics Faculty at least two weeks prior to the date of the defense. The announcement consists of the name of the candidate, the title and abstract of the research, a list of committee members, and the date, time, and location of the defense.

\* A copy of the candidate's thesis or dissertation *must* be available in the Physics Office at the time the announcement is made.

\* The Defense should be scheduled in such a way that a maximum number of faculty and graduate student can attend.

### **4. MS-I Departmental Reports:**

\* MS-I students must complete a Master's Internship (6 months minimum) in industry, a National Laboratory, or other setting appropriate for their applied emphasis area.

\* The student writes the MS Report following the internship period. It is written *in lieu* of the MS thesis, and is intended to emphasize the fundamental principles underlying the internship project. Any report must be approved by the internship sponsor to clear any sensitive proprietary material.

\* The report will be presented in an oral examination similar to the MS thesis defense. A panel of at least 2 faculty members with relevant expertise will read the report and participate in the examination. The internship sponsor will be encouraged to participate in the defense. A copy of the accepted report is kept on file in the department. The presentation serves as the MS Final Exam for this degree option.



## Appendix A: Physics Department Policy on Graduate Enrollment

Effective: January, 2009

The specific Departmental policies listed below are either dictated by the Graduate School, or have been approved as consistent with their established practices.

Full time enrollment as defined by the Graduate School is a minimum of 9 hours during a regular semester and 3 hours during any summer session. Special reductions may occasionally be allowed for students nearing completion of their final degree, and requires approval from the Graduate School.

A maximum of 13 hours in a regular semester and 6 hours per summer session is allowed by the Graduate School. Students wishing to enroll in more hours must receive special permission from the Graduate School. Minimum on-campus enrollments are 6 hrs per regular semester and 3 hrs per summer session.

A one year residence requirement for PhD students is satisfied by enrollment in a minimum of 24 hours during a 12 month period, such as 12+12 in two long semesters or 9 in each semester +6 in the summer. This has to be done one time during a student's PhD program.

Official Policy is that a graduate student must be enrolled full time any each session during which they receive a Graduate Teaching Assistantship (TA) or Research Assistantship (RA). Requests for deviation from this policy may be considered, but have seldom been approved.

If dropping a course causes a student to fall below the full time requirements, permission is required from the Graduate School in order for the Assistantship to continue. In some circumstances, the Department can arrange to add research hours after normal Add/Drop deadlines in order to avoid this problem.

A graduate student must be enrolled each semester and at least one summer session each year to satisfy the University's continuous enrollment requirements.

The Department's practice is to require 3 hours in a regular semester and 1 hour in either summer session to satisfy this minimum enrollment for unsupported students who are not on campus.

The Department requires students to sign up for PHYS 5101 three times during their first four semesters, and all TA's are expected to enroll in a 3hr Teaching Techniques course once (the first time it is offered while they are a TA); thus, typical enrollment is 10 - 12 hours for the first few semesters.

A full time student in any Physics graduate degree program must complete a minimum of 15 hours per year that apply directly to their degree plan until all degree requirements are met. Official departmental policy would allow for a maximum of one course per semester that is not on a student's official degree plan. We expect this to be used only occasionally and with permission of Advisors. Research Advisors may institute more stringent requirements for a student to be supported as an RA.

Because the official policies may be modified at any time, students and advisors should consult the relevant University OP's and the latest *Graduate Enrollment Management Policy* statements regarding any changes in official University or Graduate School policies and any special provisions with respect to maximum program hours.

## Appendix B: Financial Assistance

### Graduate Assistantships

**Teaching Assistant:** An entering graduate student is typically appointed as a TA. Stipends are set annually by the Department. Continued support as a TA is based on academic performance and satisfactory performance of assigned duties.

**Research Assistant:** Students may be supported as an RA on research grants. Stipends are comparable to those for a TA. Individual faculty members determine the specific stipends for RAs supported on their research grants.

### Scholarships and Fellowships administered by the Department

**Bucy Scholarships for Graduate Study in Applied Physics:** These scholarships are made possible by a gift from Odetta Greer Bucy and J. Fred Bucy and cover tuition and fees and also carry a generous annual stipend. This endowment was established to support students interested in applied physics, including those engaged in interdisciplinary research. Interested graduate students at all levels, including incoming students, are invited to apply.

**High Energy Physics Scholarships for Graduate Study in Particle Physics:** These competitive scholarships, made possible by the HEP group, cover tuition and fees and also carry a generous annual stipend. Graduate students interested in particle physics research, including incoming students, are invited to apply.

**Graduate Tuition Scholarships:** For incoming or continuing graduate students with high academic potential or accomplishments. Several awards are made each year. Scholarships may be disbursed as a stipend or all at one time.

**David Howe Graduate Fellowship in Physics:** Fellowships will be awarded annually to graduate students in the department. The amount varies. This fellowship endowment was established by Dr. A. Isabelle Howe in memory and honor of her husband, Dr. David Howe.

**Peter J. Seibt Graduate Fellowship in Physics:** For a new or continuing graduate student who shows promise in experimental physics. The amount varies. This fellowship was established by Mrs. Tamara Seibt and friends in memory of Dr. Seibt.

### Scholarships administered by the TTU Graduate School

Information regarding these scholarships is available via the Graduate School's website. Students may directly apply for some of these scholarships, while applications must be submitted by academic departments in other cases. Interested students can obtain the appropriate scholarship listings, detailed information, and application procedures at <http://www.depts.ttu.edu/gradschool/scholarships/>.

## **Appendix C:**

### **Performance Evaluations and Priorities for Support as a Teaching Assistant**

Incoming graduate students who receive a TA offer will normally be supported for a minimum of two semesters. Continuation of TA support is contingent on the student 1) having filed an appropriate degree plan with the Graduate School and demonstrating satisfactory progress toward that degree, 2) performing satisfactorily in their TA assignment, 3) the student's placement on the TA priority list, and availability of departmental funds.

Evaluation of progress toward a degree will be made based on performance in course work, overall GPA, timely selection of a research advisor, and research progress as determined by that advisor. Any student on academic probation will be placed low on the priority list.

Performance as a TA will be evaluated each semester by the faculty coordinator for the specific course in which the TA serves, TA ratings as obtained from student evaluation forms, and any other pertinent information. A TA shall be notified of any complaints from students, or of a less than satisfactory performance evaluation, and given a chance to respond.

Priorities for distribution of TA support are based on the following: 1) first-year students enrolled in the department's degree programs, 2) second-year students who are making satisfactory academic progress and have performed well as a TA, 3) doctoral candidates nearing graduation who have a continuing record of satisfactory performance, and 4) any other student in order of priority as determined by their overall record.

Effective 23 August 2007  
Graduate Affairs Committee

## Summary of Graduate Student Progress

(To be updated by the student each semester prior to meeting with the Graduate Advisor)

Name \_\_\_\_\_

Last Updated \_\_\_\_\_

Degree Program \_\_\_\_\_ [Physics PhD, Physics MS, Applied Physics MS]

Degree Plan filed \_\_\_\_\_ [When if Yes, No] First enrolled in \_\_\_\_\_ [Sem.]

List Courses on your Degree Plan / Semester (to be) taken / Grade (Do not list 1 hr P/F courses)

Course						
Grade / Sem						
Course						
Grade / Sem						
Course						
Grade / Sem						

List any anticipated changes to your current Degree Plan.

Your Research Advisor \_\_\_\_\_ Semester you started \_\_\_\_\_

Passed PhD Qualifying Exam \_\_\_\_\_ [When if Yes, No] Received MS \_\_\_\_\_

MS Thesis / Report \_\_\_\_\_

PhD Research Proposal Accepted \_\_\_\_\_ [When if Yes, No]

Anticipated Graduation Date (if nearing completion of program) \_\_\_\_\_

PhD Dissertation \_\_\_\_\_

Please update any of the following since your last report.

- A. Publications (title, author list, journal citation) [*URL link to full text*]
- B. Conferences you attended.
- C. Conference Presentations you gave (title, author list, conference, date, talk or poster).
- D. Conference Presentations on which you were listed as a co-author, but not the presenter.
- E. Any Scholarships or other Awards received (especially, any from outside the department).
- F. Any other professional activity you deem relevant.

The department's evaluation of your progress will also include grades on recent courses, overall GPA, timely progress in satisfying requirements for your degree program, your Advisor's evaluation of your progress in research, and a performance evaluation related to any assigned duties as a TA.

## Annual Evaluation of Research Performance

Graduate Student \_\_\_\_\_

Date \_\_\_\_\_

Student's Degree Program \_\_\_\_\_

Research Advisor \_\_\_\_\_

**Research Advisor's Evaluation:** Please write a short evaluation of the progress made by during the preceding year, and indicate your goals for this student over the near term. We expect both the evaluation and goals to have been discussed with the student. You may wish to have the full research committee involved in this process.

(To be completed by each student's research advisor, and given to the graduate advisor.)

## **Appendix D: Advanced Credit Transfers**

### **Transfer of PhD Credits and Preliminary Exam Results**

In the rare event that a student wishes to transfer into the PhD program in Physics at Texas Tech after having passed the Physics PhD Preliminary / Qualifying Examination at another University, the following guidelines apply:

1. We expect this situation to only occur when there is a strong case made for the student to undertake PhD research with a specific faculty member at Texas Tech University, and with assurance from the proposed Research Advisor that this arrangement is appropriate.
2. A minimum of half the credit hours in any degree must be taken at the Institution giving that degree (SACS Standard 3.6.3). Thus, at least 30 hrs must be taken at Texas Tech in a 60 hr PhD program, or 36 within a 72 hr program when dissertation credits are counted separately.
3. For transfer students who have a sufficient excess of previous credits, the Department will request that the Graduate School count the 12 dissertation hrs within the 60 hr PhD program. All credits to be transferred and any special requests are to be listed on the PhD Degree Plan and officially approved as per the standard procedures.
4. The type and level of the previous Preliminary/Qualifying Examination, as well as the candidate's full academic record will be considered by the Graduate Advisor and Chair of the PhD Preliminary Examination Committee in making a recommendation to the Department Chair for approval of Preliminary Exam transfer.
5. The candidate shall present a PhD Proposal to the Research Committee set up at Texas Tech for approval, as per the Department's standard procedures. This functions as final Qualifying step to official PhD Candidacy.
6. All Departmental and University regulations regarding performance of PhD research and writing and defending the PhD Dissertation shall be followed.

### **PhD plan for Candidates who hold a PhD (or equivalent)**

An Individual holding a PhD (or equivalent) degree in an area different from Physics may request to be admitted into the PhD program. The Department Chair, Graduate Advisor, and Research Advisor shall jointly decide if the request is to be granted or not.

There are no specific courses required by the department; however, SACS Standard 3.6.3 requires a majority of credits to be taken at the Institution awarding the degree. This dictates that a minimum of 30 hrs needs be taken at TTU as part of the PhD degree plan, including 12 hrs of dissertation credit. A detailed list of recommended courses depends on the candidate's background, and is prepared by the Research Advisor in consultation with the Department Chair and/or Graduate Advisor.

In order to demonstrate proficiency in Physics at the graduate level, the candidate is expected to pass the PhD Preliminary Examination within two years of declaring his/her intention to earn a PhD in Physics.

Within one year of passing the Preliminary Exam, the candidate shall have a Degree Plan, a PhD Research Advisory Committee, and present a PhD Proposal. Acceptance of the Proposal constitutes the final Qualifying step to PhD Candidacy.

The candidate shall then follow all Departmental and University procedures in place regarding the performance of research and writing and defending the PhD Dissertation.

## Appendix E:

### Procedures for the PhD Preliminary and Qualifying Exam

#### **Preliminary (Prelim) Exam:**

*The purpose of this examination is to ensure that the candidate has a good understanding of basic physics in the areas of Classical Mechanics (CM), Quantum Mechanics (QM), Electricity and Magnetism (EM), Statistical and Thermal physics (ST), and General Physics (GP), at a level consistent with the core courses offered in the Department.*

PhD candidates take the Prelim as early as possible. Normally, this is at the first opportunity after taking the core courses. If a candidate fails the Prelim, (s)he can retake it the next time it is offered. A second Fail disqualifies the candidate from seeking the PhD degree in Physics at Texas Tech University.

The Department's Chair appoints a Committee of five faculty members to run the Prelim. The Committee should be representative of the research interests in the Department. The Committee uses the following guidelines to organize the written and oral parts of the Prelim and decides on the outcome (Pass/Fail) of the exam.

The Prelim is to be offered in Dec 2009 under the current schedule. Starting in August 2010, the Prelim will be offered the week before the beginning of the Fall semester. A second offering between the Fall and Spring semesters is possible if a sufficient number of students who should be taking it.

The Prelim consists of a written and an oral examination. Both examinations are taken within four days. A Pass corresponds to a Prelim grade of 60% or higher. Borderline cases (55-60%) are examined by the Committee and a vote decides the final outcome.

**The Written Exam** takes place in two half-day periods on consecutive days. During each period, the candidate solves any three of four problems encompassing CM, QM, EM, ST, and GP. The problems emphasize physics over mathematical methods. The Committee appoints two graders per problem. Should the two grades differ by more than 25 out of 100 points, the Committee as whole re-grades that problem. The written exam counts for two-thirds of the Prelim grade.

**The Oral Exam** takes place within a few days after the written exam and is administered by the Prelim Committee. Each Committee member is assigned to ask questions in one of the five areas (CM, QM, EM, ST, and GP). Each Committee member assigns a grade to all the answers. The oral exam lasts 50 minutes. The Committee averages these grades, which then counts for one-third of the Prelim grade.

#### **Qualifying Exam (Qualifier): Presentation of Research to Date and PhD Proposal**

*The purpose of the Qualifier is twofold: First to ensure that the candidate has acquired the basic skills necessary to conduct research at the PhD level; second to ensure that the research project is at a level appropriate for the PhD degree and that the Candidate is prepared to undertake the PhD research project. The two exams are normally taken in short succession.*

The Qualifier must be completed within twelve months of the Candidate passing the Prelim. Under special circumstances, an extension of up to 12 months may be granted by the Graduate Adviser.

**Presentation of the Research to date:** This exam consists of a Report (max: 10 pages) and an oral presentation of the research accomplished to date, either as part of the PhD project or a MS Thesis or Report. It is a 30-40 minute presentation followed by questions. The presentation of the research done by the Candidate is a public event. All faculty and students are encouraged to participate. The quality of the Candidate's presentation and answers to questions from the public audience and then from the

Research Committee (in a private session) are expected to be above the minimum expected at the MS level. At the end of the exam, the Research Committee decides if the Candidate passes or fails. If the candidate fails this exam, (s)he can take it a second and last time within six months. The Candidate must Pass the Presentation of Research performed to date before Defense of the PhD Proposal.

**Proposal Defense:** This exam consists of a Proposal (max: 15 pages) and Defense of the PhD research to be done. The PhD Proposal must be approved by the Candidate's Research Advisor and distributed to the members of the Research Committee at least one week before the scheduled Proposal Defense. The Candidate should demonstrate that (s)he has examined the relevant research literature, understands how the proposed project fits into that existing background, and develops new knowledge. The Candidate must show that (s)he is competent with the experimental or theoretical techniques used in performing that research. Defense of the PhD Proposal takes place in a private session with the Research Committee. It involves a brief (~20 minutes) presentation by the Candidate followed by questions from the Committee.

The Research Committee determines whether the Candidate has Passed or Failed the Proposal Defense and promptly informs the Candidate of the result. There is no provision for a second attempt at the Proposal Defense, but the Committee may choose to reconvene within 30 days to address a specific deficiency if the performance is otherwise satisfactory.

The Research Advisor informs the Graduate Advisor of the result, and the Graduate Advisor then informs the Graduate School that a Candidate has passed the Qualifier and is eligible to be designated as a PhD Degree Candidate. Then, the Candidate officially has four years to complete the research project and defend a PhD Dissertation.



## Appendix F:

### Style Guides for Theses and Dissertations for Degree Programs administered by the Department of Physics: Discipline Specific Reference Formats

The Department of Physics has agreed to use the default selected by the Graduate School as the general style manual for MS Thesis and PhD Dissertations; Kate L Turabian, *A Manual for Writers of Term Papers, Theses, and Dissertations*, which is based primarily on the *The Chicago Manual of Style*. However, the Department wishes to specify that the style and format for references and how they are cited in the text as well as in figure or table captions should follow the format established by the American Physical Society (APS) and American Institute of Physics (AIP) for the journals they publish. The details are available in the *AIP Style Manual* or the much shorter *Physical Review Style and Notation Guide*, both of which are available from the APS website ([www.aps.org](http://www.aps.org)) under 'journals' and then 'authors'. The attached table shows the standard APS/AIP formats for the reference types most often encountered.

References should be (a) placed at the end of the main document but before any Appendices, rather than at the end of each chapter, and (b) listed in the order in which they are first cited in the text. Citations in the text and the item number in the reference list should follow the on-line citation format as [xx], where "xx" is the numerical order of first use. With the exception of High-Energy Physics where very large collaborations are common, all authors should be listed for each reference, rather than using the "*et al.*" format. This is the most common style as seen, for instance, in *Physical Review Letters*. Large collaborations should be cited in the format commonly used for such references in the *Elementary Particles and Fields* section of this journal. More specifics are provided in Sect. II. J. of the *Physical Review Style and Notation Guide*. A list of journals and the standard abbreviations for their names are included in an Appendix to that guide. Only these official APS/AIP abbreviations should be used in the Reference section of Theses and Dissertations.

Students should pay careful attention to these style manuals and the Department's specific Reference format instructions in preparing their Theses or Dissertations in addition to any other format related instructions provided by the Graduate School. The Graduate School has information regarding the Department's format choices on file for use when checking and accepting or rejecting the formats of these documents.

The attached table, taken from the *Physical Review Style and Notation Guide*, shows the reference formats established by APS/AIP and adopted by the Physics Department as our standard for use in MS Theses and PhD Dissertations.

Adopted by the Physics Department

March 2006

TABLE I. *Physical Review* has established general forms to make the presentation of reference information as simple and concise as possible. Follow the instructions below and use these forms in the final reference list. Comments pertaining to a particular reference are enclosed in square brackets at the end of some examples. For a list of the standard journal abbreviations, please see the Appendix.

Type	Entry in final reference list or at bottom of the page
<b>Introductory type (1)</b>	*Present address: Physics Department, Auburn University, Auburn, AL 36849. †On leave from Brookhaven National Laboratory, Upton, NY 11973. ‡Corresponding author.
<b>Text type (2)</b>	
<b>(a) How to list authors</b>	
One author:	J. M. Smith, Phys. Rev. B <b>26</b> , 1 (1982).
Two authors:	J. M. Smith and R. Brown, Phys. Rev. B <b>26</b> , 1 (1982).
Several authors (e.g., ten or fewer):	J. M. Smith, R. Brown, C. Green, D. Jones, and A. Lee, Phys. Rev. B <b>46</b> , 1 (1992).
Only if length constrained and four or more authors:	J. M. Smith et al. Phys. Rev. B <b>46</b> , 1 (1992).
Large collaboration (collaboration name should be given if it appears in the byline of the cited article):	J. M. Smith et al. (XYZ Collaboration), Phys. Rev. D <b>46</b> , 1 (1992).
<b>(b) How to list sources</b>	
One source:	J. M. Smith, R. Brown, C. Green, and A. White, Phys. Rev. B <b>26</b> , 1 (1982).
Two sources:	J. M. Smith, Phys. Rev. B <b>26</b> , 1 (1982); Nucl. Phys. <b>A195</b> , 1 (1982). [Note that a semicolon is used between sources.]
Three or more sources:	J. M. Smith, Phys. Rev. B <b>26</b> , 1 (1982); Nucl. Phys. <b>A195</b> , 1 (1982); Phys. Lett. <b>16A</b> , 1 (1982).
<b>(c) How to list same author, same source, different volume and page</b>	J. M. Smith, Phys. Rev. B <b>24</b> , 3 (1981); <b>26</b> , 1 (1982).
<b>(d) How to list same author, same source, same volume number, same year, and different page numbers</b>	J. M. Smith, Phys. Rev. B <b>26</b> , 1 (1982); <b>26</b> , 6 (1982). [Note that both page numbers are listed separately.]
<b>(e) How to list different authors and different sources</b>	J. M. Smith, Phys. Rev. B <b>26</b> , 1 (1982); R. Brown, <i>Heavy Ions</i> (Academic, New York, 1982); C. Green, Ph.D. thesis, Brown University, 1980.
<b>(f) How to list different authors, same sources</b>	J. M. Smith, Phys. Rev. B <b>26</b> , 1 (1982); R. Brown, <i>ibid.</i> <b>24</b> , 3 (1981); C. Green, <i>ibid.</i> <b>24</b> , 22 (1981). [Note that <i>ibid.</i> is used instead of repeating the journal name.]
<b>(g) How to list multiple parts in a single footnote</b>	(a) J. M. Smith, Phys. Rev. B <b>26</b> , 1 (1982); (b) R. Brown, Nucl. Phys. <b>A195</b> , 1 (1982).
<b>(h) Journals</b>	J. M. Smith, Phys. Rev. B <b>26</b> , 1 (1982). [published] J. M. Smith, Phys. Rev. D (to be published). [accepted for publication] J. M. Smith, Phys. Rev. B <b>26</b> , 706(E) (1982). [erratum]  J. M. Smith, Zh. Eksp. Teor. Fiz. <b>51</b> , 165 (1966) [Sov. Phys. JETP <b>24</b> , 11 (1967)]. [Russian journal reference with English journal translation]

(i) Books	<p>J. M. Smith, <i>Molecular Dynamics</i> (Academic, New York, 1980), Vol. 2, p. 20. [published, use italic title; additional information (Vol., Chap., Sec., p., etc.) as appropriate]</p> <p>J. M. Smith, in <i>Molecular Dynamics</i>, edited by C. Brown (Academic, New York, 1980). [published, use italic title; for edited works use form “in” and “by”]</p> <p>J. M. Smith, <i>Molecular Dynamics</i> (Academic, New York, in press). [in the process of being published, use italic title and the form “in press”]</p>
(j) Proceedings	<p>J. M. Smith, in <i>Proceedings of the International Conference on Low Temperature Physics, Madison, 1958</i>, edited by C. Brown (University of Wisconsin, Madison, 1958), p. 201. [published, use italic title; edited form as above]</p> <p>J. M. Smith, in Proceedings of the International Conference on Low Temperature Physics, Madison, 1958, edited by C. Brown (unpublished). [not published, use roman title; edited form as above]</p> <p>J. M. Smith, in <i>Low Temperature Physics</i>, proceedings of the International Conference, Madison, Wisconsin, edited by C. Brown (University of Wisconsin, Madison, 1958). [shortened published title, use italic title with descriptive information following; edited form as above]</p>
(k) Reports	<p>J. M. Smith, Brookhaven National Laboratory Report No. 10, 1982 (unpublished). [Most reports are considered to be unpublished. Those reports considered as full publications should be designated without the parenthetical unpublished at the end of the reference.]</p>
(l) Preprints (journal specific)	<p>J. M. Smith, Brookhaven National Laboratory Report No. 110, 1992 (to be published).</p>
(m) Theses	<p>J. M. Smith, Ph.D. thesis, Brown University, 1980.</p>
(n) Others	<p>J. M. Smith (private communication).</p> <p>J. M. Smith (unpublished).</p> <p>J. M. Smith as discussed in A. Jones, <i>Phys. Rev. B</i> <b>26</b>, 1 (1982). [cited in another paper]</p> <p>J. M. Smith, computer code CRUX, Bell Laboratories, Murray Hill, NJ, 1972.</p>