PHYSICS GRADUATE STUDENT HANDBOOK

DEPARTMENT OF PHYSICS
UNIVERSITY OF UTAH

SPRING 2008

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UNIVERSITY OF UTAH

1. GENERAL PROGRAM

A student undertakes graduate study in physics to accomplish three goals: first, to develop a broad and sophisticated knowledge of the field as a whole; second, to acquire a deep and thorough understanding of some specialized field, and to contribute to the body of knowledge of that field through his or her own research; and third, to prepare the foundation for a rewarding career. It is important to note that obtaining a Ph.D. in physics does not limit one to a career in physics per se; physicists over the past decades and centuries have contributed to the creation of entirely new sciences ranging from chemistry to electronics, from geology to computer science. By virtue of their trained ability to isolate the critical aspects of complex phenomena, construct models, and thereby solve problems (whether theoretical or experimental), Ph.D. physicists find themselves sought after by a wide variety of industries. (These even include financial investment firms!)

The general requirements for the Ph.D. degree are given in the Graduate School Bulletin, which each student should obtain (http://www.sa.utah.edu/admiss/graduate.htm). In addition to the requirement of at least 14 credit hours of thesis research (PHYCS 7970), a student must have mastered the subject matter of the core courses described below to the satisfaction of the student's supervisory committee. Two examinations precede the writing of the Ph.D. thesis: first, the Common Examination, as described in Section 6, taken at the beginning of graduate work to verify general competency in the basic areas of physics; second, the Qualifying Examination, described in Section 7, is taken after a student has chosen the topic for his or her thesis. After a penultimate version of the dissertation has been submitted to the Supervisory Committee, a final "thesis defense" is conducted in the format of a public seminar followed by a private discussion with the candidate's Supervisory Committee.

2. COURSES TO BE TAKEN

The student's first responsibility as a new graduate student is to remedy any deficiencies at the advanced undergraduate level. In consultation with his/her assigned Graduate Student Counselor (a member of the faculty), the student also should choose mathematics courses that will provide an adequate background for his/her graduate physics courses.

It is necessary that a graduate student in physics be computer literate. For those who are deficient in this regard, we recommend that you enroll in PHYCS 6720 (Introduction to Computing in Physics). This course will provide you with some of the basic tools needed for your Ph.D. research. This course may count as an elective course.

The required core courses for the Ph.D. program, and the recommended sequence for taking them, are given in the table below. A standard sequence and an alternative sequence are shown. Depending upon a student's Common Exam performance and in consultation with the student's advisor, the alternate sequence may be elected. This sequence provides a two-semester remedial sequence (5010-5020) designed to further prepare the student to pass the Common Exam and for the more advanced courses.

Standard Curriculum

	Fall semester	**Spring semester**
Year 1	PHYS 7110 – Class Mech/E&M I	PHYS 7120 – E&M II
	PHYS 7740 – Math Methods I	PHYS 6719 – Graduate Lab
Year 2	PHYS 7220 – Quantum Theory I	PHYS 7230 – Quantum Theory II
	PHYS 7310 – Stat Mech	Elective

Alternate Curriculum

	Fall semester	Spring semester
Year 1	PHYS 5010 – Theor Mech & QM	PHYS 5020 – Theor E&M/Stat Mech
	PHYS 7740 – Math Methods I	PHYS 6719 – Graduate Lab
Year 2	PHYS 7110 – Class Mech/E&M I	PHYS 7120 – E&M II
	PHYS 7220 – Quantum Theory I	PHYS 7230 – Quantum Theory II
Year 3	PHYS 7310 – Stat Mech	Elective

All Ph.D. students in the first three years are required to enroll each semester in PHYS 7800, the Colloquium, which requires weekly attendance at department colloquia. Beginning with the third year, students may enroll in more specialized Graduate Seminars (such as PHYCS 7810) courses in lieu of PHYS 7800. In planning your program, please note that some courses are taught only once per two years.

The remainder of a student's elective courses can be chosen from the Course Catalog, and will most likely be in the area of a student's specialization. One elective course must satisfy a “breadth requirement”, meaning that it is clearly outside the area of a student’s specialization. These courses are determined by consulting with the student’s supervisory committee.

Even before passing the Common Exam, a motivated student may consult with potential thesis advisors and in some cases, work in a research group. Having passed the Common Exam, all students should select a thesis advisor and complete the "Departmental Request for Supervisory Committee" form in consultation with student's assigned Graduate Counselor. The chair of the supervisory committee then becomes the student's principal advisor. The Supervisory Committee will assist the student in formulating the remainder of his or her program of study. The Supervisory Committee has the final say on which courses are required.

The Ph.D supervisory committee nominally consists of 4 Faculty members from within the Physics department, and one external faculty member (from another Department on Campus). The external committee member is a requirement of the University Graduate School. The chair of the Ph.D supervisory committee is normally the supervisor of the student’s research, and must be a faculty member in the Department of Physics. In certain circumstances the research supervisor is not a member of the Physics department faculty, and in this case the research supervisor is a member of the Ph.D supervisory committee, but he/she is not the chair of the committee. In certain cases it may be acceptable to have six committee members on the supervisory committee, by petition to the University Graduate School.

The composition of the Ph.D supervisory committee is to be made in consultation with the supervisory committee chairman (and the research supervisor, if they are not the chairman). According to Departmental policy, the supervisory committee should include faculty members with a concentration of expertise in the subject matter of the Ph.D, as well as a component of expertise substantially outside of the main Ph.D subject area. The diversity requirement also requires representation by faculty members in both theoretical research and experimental research.

For example, a standard Ph.D supervisory committee in experimental condensed matter physics would consist of three faculty members in condensed matter physics, an external faculty member from outside the Department (with an interest in the subject), and a faculty member in astronomy or particle physics. Within this committee, four of the members would be primarily experimentalists, and one faculty member would be primarily a theorist. A standard Ph.D supervisory committee in theoretical astrophysics would consist of three faculty members in astronomy/astrophysics, and external faculty member from outside the Department, and a faculty member is atomic, molecular, optical, or condensed matter physics. Within this committee four of the members would be primarily theoreticians, and one would be primarily an experimentalist. ***The overall composition of a committee must be approved by the Physics***

Department Director of Graduate Studies (DOGS). In general, the DOGS will approve Ph.D supervisory committees only if they are composed in accordance with the above Departmental guidelines.

A well prepared student may, with the consent of the instructor, elect to satisfy the core course requirement in any sequence (with the exception of PHYS 6719) by passing the final examination in each semester of the sequence with a grade of B or better, rather than registering for the course. An exceptionally well-prepared student from another institution may petition his or her Ph.D. Supervisory Committee to waive the requirement of completing any or all core courses. The Committee must be convinced that the student has had equivalent course work elsewhere and performed at an adequate level. A simple statement from the committee chairman, explaining the reasoning for the waiver of required course work, must accompany the Program of Study Form when sent to the Director of Graduate Studies.

A student pursuing a Ph.D. in a field of specialization with a strong overlap in another department may, with the consent of his or her Supervisory Committee, substitute one or two core courses from another department at the University of Utah for the core courses listed above.

Within one semester of the formation of the Supervisory Committee, the student should obtain its approval of a "Program of Study" for the Ph.D., which lists the remaining courses to be completed. At the same time the Committee should set a date for the Ph.D. Qualifying Examination, described in Section 7 below. Having passed this examination, the student will normally devote the balance of his/her non-teaching time to research, specialized courses, and the writing of the dissertation. It is recommended that the committee meet to discuss the Program of Study and topical areas to be covered in the Qualifying Exam.

Every graduate student receiving a tuition waiver is required to take 9-12 hours per semester!
Once a student has 84 graduate credit hours, a tuition waiver will only cover additional research hours (not academic course work). Only 11 hours of coursework per semester can be covered by a Research Assistantship (RA). A Teaching Assistantship (TA) can cover up to 12 hours of course work per semester. In the summer semester, tuition waivers will be granted only to those with RAs, and will only cover up to 3 hours of research credits (no academic course work).

The time limit for the Ph.D. is six years from matriculation unless the student has completed a Master's degree in physics prior to matriculation at the University of Utah, in which case, it is four years. In exceptional cases the time limit may be extended for a period of up to one year at a time. According to graduate school policy, requests for an extension of the time limit must be recommended by the student's supervisory committee and approved by the Director of Graduate Studies and the Dean of the Graduate School. The request will be acted upon favorably only if there is a realistic expectation that the student will finish within the period of the extension.

3. Residency Requirement

At least one year (i.e., two consecutive semesters) of the doctoral program must be spent in full-time academic work at the University of Utah. When a student proceeds directly from a master's degree to a Ph.D. degree with no break in the program of study (except for authorized leaves of absence), the residency requirement may be fulfilled at any time during the course of study. A full load is nine credit hours. Three hours of Thesis Research: Ph.D. (course number 7970) also is considered a full load after the residency requirement is fulfilled.

4. Language Requirements

All students are expected to be proficient in English. International students should have a minimum TOEFL score of 575 on the paper-based test, or 232 on the computer-based test; students with TOEFL scores below 600 (paper-based test) or 250 (computer-based test) may be required to enroll in English classes. Students will find it useful to live in a residence or dormitory in which only English is spoken. All students for whom English is not the first language should pass the Versant test within first year of matriculation.

5. GRADING

The department has adopted the following grading schedule - note that a grade of B- is below the acceptable grade level for Ph.D. students

A excellent work, Ph.D. caliber
A- good work, acceptable at Ph.D. level
B+ good work at a level that would indicate probable passing level for the common or qualifying examination
B mediocre work--marginal for Ph.D.--no prediction possible
B- Lowest grade acceptable for Master's degree. Below acceptable level for Ph.D. degree
C unacceptable

Of course, these grades do not guarantee any results in the common or qualifying examinations, but are an indication of how similar performance on the examinations would be regarded. A student intending to obtain a Ph.D. who receives a grade below B in any of the required core courses, or in any course deemed vital by his or her committee, is required to repeat that course, or to pass satisfactorily an equivalent final examination. (The exam can be oral or written as determined by the student's supervisory committee.) Once the committee identifies courses as being required, it cannot waive this minimum grade point requirement.

6. THE COMMON EXAMINATION

(a) The Purpose of the Exam

The Common Examination is used to determine whether a student is officially allowed to become a candidate for a Ph.D degree, and is an important indication that the student is progressing. Before passing this exam, a student cannot form a Ph.D supervisory committee. Candidates for the M.S. Degree are not required to take the Common Examination, although the exam is very useful as a diagnostic in determining which courses should be taken upon entering the program. The result of the test is also taken into account in the renewal of teaching assistantships and in nominations for fellowships.

(b) The Structure of the Exam

The examination consists of a written examination to be taken in two three hour periods on a single day shortly before the start of fall semester classes. The outcome of the common exam is based solely on the student's score on the written examination. If a student's score is above a "full pass threshold", the student will have satisfied the common exam requirement. If a student's score lies below the "full pass threshold" but above the "conditional pass threshold" the student will be directed to complete either PHYS 5010 and/or PHYS 5020 with a minimum grade of A-. A student with a conditional pass who satisfies the prescribed course requirements will have satisfied the common exam requirement. If a student's score lies below the "conditional pass threshold", the student will have failed that attempt at the common examination.

The written examination will be confined to undergraduate course work, and will include the following subjects (levels are indicated by reference to Physics course numbers at the University of Utah):

1. General physics (at the level of 2210, 2220, 2230)
2. Thermodynamics and statistical mechanics (at the level of 3760)
3. Classical mechanics and special relativity (at the level of 4410, 4420)
4. Quantum theory and modern physics (at the level of 3740, 5450, 5460)
5. Electricity and Magnetism (at the level of 4410, 4420)

Copies of earlier exams may be obtained from the Physics Department website at www.utah.edu/academics.html.

(c) When the Exam Must Be Taken

The exam must be passed by the start of the second year of graduate work. A student is expected to take the exam just prior to the Fall semester in which the student starts graduate work. If the student fails that first attempt, a second attempt is permitted in the Fall of the following year. Students admitted to graduate work in the Spring semester are treated, for this purpose, as having started graduate work in the Fall semester of the following academic year. Students who register for Fall semester, but who arrive too late

to take the written examination, will have forfeited their first attempt at the common examination. Students may petition the Common Exam Committee for a third attempt at the exam, but such a petition will be granted only for special circumstances.

7. THE PH.D. QUALIFYING EXAMINATION

At the time the Supervisory Committee approves the program of study, a tentative date will be set for the Qualifying Examination. At the same time the Committee should determine the format and topical subjects of the examination following these guidelines: this is an examination designed to test the student's mastery of physics typified by the core Ph.D. courses, as well as his or her awareness of current physics as exemplified by current scientific literature and departmental colloquia. The examination may also focus on a student's particular area of specialization. There may be a written portion. However in recent tradition an oral exam has been more typical.

According to Graduate School policy, an examination or parts of an examination may be repeated only once and only at the discretion of the student's Supervisory Committee. When the student passes the Qualifying Examination, he/she should obtain the forms "Report of the Qualifying Examination for the Ph.D." and "Recommendation for Admission to Candidacy" from the Graduate Records Secretary. These forms should be completed with appropriate signatures then returned to the secretary who will make copies and forward the originals to the office of the Graduate School.

8. MASTER'S DEGREE FOR PH.D. CANDIDATES

While the MS or MA degree is not a prerequisite to obtaining a Ph.D., students in the Ph.D. program are strongly encouraged to complete formalities for a non-thesis (Milestone) Master's degree after they have completed the course requirements.

The M.S supervisory committee nominally consists of 3 Faculty members from within the Physics department. The chair of the M.S. supervisory committee is normally the supervisor of the student's research, and must be a faculty member in the Department of Physics. In certain circumstances the research supervisor is not a member of the Physics department faculty, and in this case the research supervisor is a member of the M.S. supervisory committee, but he/she is not the chair of the committee. In certain cases it may be acceptable to have additional committee members on the supervisory committee, by petition to the University Graduate School.

The composition of the M.S. supervisory committee is to be made in consultation with the supervisory committee chairman (and the research supervisor, if they are not the chairman). According to Departmental policy, the supervisory committee usually includes 2 faculty members with a concentration of expertise in the subject matter of the M.S, and a faculty member with expertise substantially outside of the main M.S. subject area. If possible, the diversity requirement also requires representation by faculty members in both theoretical research and experimental research (although this may be difficult with only three committee members). The overall composition of a committee must be approved by the Physics Department Director of Graduate Studies (DOGS). In general, the DOGS will approve M.S. supervisory committees only if they are composed in accordance with the above Departmental guidelines.

9. THESIS

A variety of thesis research topics are available in the Physics Department. Interdisciplinary research (and degrees) involving physics and other disciplines may be arranged. Thesis research is expected to involve an original and publishable contribution to knowledge. By the time of the final oral thesis defense, a paper embodying the results of the thesis research should have been submitted to a reputable scientific journal. (Under special circumstances, and with the concurrence of the thesis advisor, submission may be delayed for a limited time beyond the date of the final oral thesis defense.)

When the student has pursued his or her research to the point of knowing its general scope and conclusions and has begun to write the thesis he/she should meet with his/her Supervisory Committee and obtain their approval of the thesis content and results to be described before completing the writing of the thesis. When the rough draft of the thesis has been written, he should give copies to the committee members so that suggestions they may make can be incorporated into the final version. (This should be

done at least two weeks prior to the final oral thesis defense.) Two weeks prior to the final oral thesis defense, he/she must make arrangements for a public seminar in which his/her research is described. The time is arranged with the Graduate Records Secretary, and must be acceptable to the committee members. The student is responsible for notifying the Graduate Records Secretary of the final oral thesis defense two weeks in advance so that the public seminar can be adequately publicized. The final oral thesis defense will then consist of the public seminar, followed by a private meeting between the student and his/her committee.

MASTER'S DEGREE PROGRAM

1. GENERAL REQUIREMENTS

The general requirements for the Master's degree may be found in the current Bulletin of the Graduate School which each graduate student should obtain (http://www.sa.utah.edu/admiss/graduate.htm).

Master's degree candidates are matriculated if their undergraduate records and Graduate Record Examination score indicate an ability to do graduate work in physics.

A thesis and a thesis defense as described in the last paragraph of Section 8 above are encouraged, and ordinarily required for the Master's degree. However, a student may arrange to substitute supplementary course work and a satisfactory performance on a specialized examination for this requirement. The M.A. degree requires a foreign language. The M.S. does not. Briefly, candidates for M.S. or M.A. must devote 30 credit hours to courses and thesis. A non-thesis Master's student must pass a specialized exam, associated with his or her particular program, administered by the Master's Supervisory Committee.

2. PHYSICS DEPARTMENT PROGRAMS

In the Physics Department, there are a number of approaches to the Master's Degree, including the Instrumentation Physics Program and Master's in Computational Physics discussed later. Students who plan ultimately to obtain a Ph.D. may wish to take courses required for the Ph.D. program in developing a program of study for the Master's degree. For students who wish to move from physics into related fields of medicine, geology, engineering, education, or business, individual M.S. or M.A. programs can be designed with emphasis on the new field.

3. COURSES TO BE TAKEN

In planning the initial program of study the student should confer with the assigned Graduate Student Counselor. Normally no later than the second year, the Master's student should talk with potential advisors in his or her area of interest. When a Masters advisor has been selected, a form entitled "Request for Supervisory Committee" is to be completed. Within one semester of the formation of a Master's Supervisory Committee, a student should file an "Application for Admission to Candidacy for the Master's Degree" with the approval of the Committee. This application includes a list of courses to be completed. The Graduate School sets a four year time limit for the Master's degree. In meritorious cases the time may be extended with the approval of the student's Supervisory Committee and the Dean of the Graduate School.

A student must maintain minimum registration as specified in the Bulletin of the Graduate School.

MASTER'S DEGREE IN INSTRUMENTATION PHYSICS

1. GENERAL PROGRAM

This program is designed to qualify those with training in various scientific and engineering fields to understand, work with and develop modern numerical methods, electronics, measurement system characterization, computer data acquisition/control, and the physical principles of the operation of various measurement transducers and sensors. The degree candidate is required to take part in an instrumentation project which can be in a wide variety of research and industrial test areas. In many cases the project will occur in disciplines other than physics and can be performed in an industrial setting with appropriate departmental supervision. The physics is to be fully documented and a detailed written report of the project is to be presented in lieu of a thesis to the student's Master's Supervisory Committee prior to obtaining its approval for the granting of the Master's Degree (non-thesis).

2. BACKGROUND

A well-qualified applicant should have a B.S. or B.A. degree with an undergraduate grade point average of 3.0 or higher and should have completed a calculus-based physics sequence. Remedial work as well as advanced standing will be considered in individual cases by the Instrumentation Physics Counselor.

3. COURSES TO BE TAKEN

A total of 30 semester hours of credit are required to complete the program. Six to ten will be related to the instrumentation project. The Instrumentation Master's Program core courses are shown below.

Required Core Courses:		Credit Hours:
PHYS 6610	Electronics I	4
PHYS 6620	Electronics II	4
PHYS 6750	Applied Modern Optics I & II	4
PHYS 6770	Optical Measurement Techniques & Instrumentation	4
PHYS 6730	Computational Physics*	4
PHYS 6859	Instrumentation Project	6-10
Optional Preparatory Courses:		
PHYS 5010	Theoretical Mechanics & Quantum Mechanics**	3
PHYS 5020	Theoretical E&M and Statistical Mechanics**	3
PHYS 6720	Intro. to Computation in Physics*	4
Elective Courses:		
PHYS 6771	Ionizing Radiation***	2
	Machine Shop****	20 real-time hours
PHYS 5719	Lab Techniques	3
PHYS 5739	Microscopy	2

Select courses above the 5000 level in physics, chemistry, mathematics, computer science, and engineering may be substituted for the instrumentation courses above with prior approval from a student's Supervisory Committee. These courses should be in fields relevant to the Instrumentation Project.

*The introductory computational course (6720) is not required. It is suggested for those who require an introduction to Unix workstations and C++ programming.
**The theoretical physics sequence (5010-5020) is not required. It is suggested for those whose physics background is limited and for those who want a broader physics background.
***The ionization course (6771) is recommended but offered less frequently.
****Machine shop is a non-credit four week training class offered in the physics department. This class is not required. This class is suggested for those who plan on using the machine shop facilities for their instrumentation project and research and is required for students to work themselves in the machine shop.

4. SUGGESTED PROGRAM

The suggested program for an Instrumentation Master's Program student who has an adequate background in quantitative science is shown below. Such a student, taking 8 hours (2 classes) per semester, can complete the program in four semesters.

Fall		Spring	
1st Year:			
6610 Electronics I	4	6620 Electronics II	4
6750 Applied Modern Optics I & II	4	6730 Computational Physics	4
2nd Year:			
5719 Lab Techniques	3	6770 Optical Meas. Technique & Inst.	4
6771 Ionizing Radiation	2	6859 Instrumentation Project	1-9
6859 Instrumentation Project	1-9	6859 Instrumentation Project	1-9

5. INSTRUMENTATION PROJECT

The Instrumentation Master's Program Project may be work related, related to a professor's research, or of personal interest (consider capability to finance personal interest projects). Work related projects including proprietary and/or confidential research have been accommodated in the past.

Instrumentation Projects by previous students are posted in the Physics Library.

Suggested Time Line:

Start of 1st Year:

- Confer with the Departmental Graduate Student Counselor for the Instrumentation Master's Program

End of 1st Year:

- Inquire about possible topics.
- Propose possible topics with Instrumentation Master's Program professors or Supervisory Committee members

Start of 2nd Year:

- Complete departmental "Request for Supervisory Committee"
- File an "Application for Admission to Candidacy for the Master's Degree" with the approval of the Supervisory Committee
- Oral Proposal with Supervisory Committee

End of 2nd Year:

- Present Instrumentation Project to Supervisory Committee

Short descriptions of these and other courses can be found in the current General Catalog of the University of Utah.
http://www.acs.utah.edu/gencatalog/index.html

In planning the initial program of study, a student should confer with the Departmental Graduate Student Counselor for the Instrumentation Master's Program. Normally, by the beginning of the second year, the Instrumentation Master's student should have selected a project and a project advisor and completed the departmental "Request for Supervisory Committee".

Shortly after forming the Supervisory Committee, the student will make a formal presentation of the proposed instrumentation project to the Committee, detailing the rationale for the project, methods and/or resources to be employed, a discussion of project feasibility, and a timeline for completion. This detailed

project presentation will be presented as a short oral report (15-20 minutes) to the student's Supervisory Committee for approval prior to the initiation of the project, and will serve as the Student's Qualifying Exam for the Master's Degree. The student will also file an "Application for Admission to Candidacy for the Master's Degree" during the Qualifying Exam meeting, to be approved by the Supervisory Committee. This application includes a list of courses to be completed. A final formal oral presentation to the Supervisory committee of the project, and a detailed project write-up are required for completion of the degree. A copy of the Project write-up must be placed in the Physics Library (see Graduate Records Secretary for details)

As a general rule, MSI students are not entitled to financial support by the Physics Department. Many students pursue this degree while working full time jobs in industry to support themselves.

Chemical Physics Ph.D. Program

1. General Program

The chemical physics program is an interdisciplinary graduate curriculum permitting maximum flexibility to well-qualified graduate students seeking advanced training for research in areas of common interest to physics and chemistry. This program of study leading exclusively to the doctoral degree is administered by the executive committee for chemical physics of the Departments of Chemistry and Physics. Course work requirements are tailored to meet the need and interests of students on an individual basis in consultation with the student's Supervisory Committee.

2. Faculty

Several faculty members of the Departments of Chemistry and Physics are available to supervise thesis research in this program. As of September 2007 those who have indicated availability include, in Physics, Professors Boehme, DeTar, Gerton, Harris, Lupton, Saam, Symko, and Vardeny; and in Chemistry, Professors Anderson, Armentrout, Bartl, Flynn, Grant, Molinero, Morse, Schumaker-Parry, Truong, Voth, and Wight.

3. Procedure

Students desiring to pursue a degree in Chemical Physics may be admitted to the program as soon as they have met the preliminary requirements for admission to the doctoral program in one of the cooperating departments. In Physics, this point is reached when a student has passed the Common Examination; in Chemistry, the corresponding point is placement of the student by vote of the Departmental faculty in "Category I".

Once students have met the requirements for entry into the program, they complete their admission by submitting the form "Request for Supervisory Committee", giving the names of faculty members whom they have consulted for research topics in Chemical Physics, the name of their selected thesis advisor and probable thesis research project, and certain other information. This form should be turned in to the Chairman of the Chemical Physics Program who will thereupon appoint a thesis supervisory committee. This committee will then meet with the student and work out with him or her a suitable program of study and an acceptable selection of topics for the Chemical Physics Ph.D. Qualifying Examination. This examination will be administered by the student's thesis committee after the student has become prepared through completion of suitable courses and independent study. The results of the Chemical Physics Qualifying Examination and the program of study approved by the supervisory committee will be forwarded to the Chairman of the Chemical Physics Program for final approval and certification, then sent to the Director of Graduate Studies and to the Graduate School.

It will also be the responsibility of the thesis advisory committee to monitor the progress of the student and recommend to the Chairman of the Chemical Physics Program any actions intended to encourage appropriate progression toward a degree or, where necessary, to terminate the student's participation in the program.

4. Thesis

When the student's thesis research has progressed to the point of knowing its general scope and conclusions he/she should obtain from the Supervisory Committee members their approval of the thesis content and results, and should then complete a rough draft and give the committee members an adequate opportunity to make suggestions for incorporation into the final version. A final oral examination is then scheduled, which will consist of a public presentation of the student's thesis followed by a private meeting with the student's thesis committee on the thesis work and on any additional topics that the committee has indicated will be included in the examination.

5. Administration

For the 2007-2008 academic year, the co-Chairs of the Chemical Physics program are

Professor Carleton DeTar, Department of Physics
Office: 212 INSCC, telephone 581-7537, e-mail: detar@physics.utah.edu

Professor Michael Morse, Department of Chemistry
Office: 3428 HEB, telephone 581-8319, e-mail: morse@chem.utah.edu

Additional information concerning the program and any needed forms may be obtained from either of the administrators listed above.

Master's Degree in Computational Physics

1. GENERAL PROGRAM

The Department of Physics offers a Computational Physics option under its regular M.S. program in cooperation with the Departments of Mathematics and Computer Science. This program is intended to equip students in science and engineering disciplines with modern computational skills for use in solving problems in the physical sciences.

Degree requirements include classes in numerical analysis using networked Unix workstations in an X-window environment, physics core and specialty courses, and a computational physics project. The project may be developed in cooperation with a student's employer or in conjunction with a University research group. A detailed project report is required (nonthesis option). Electives include scientific visualization, architectures and algorithms, minicomputer interfacing with experimental apparatus, and case studies in computational engineering and science. Course requirements are designed to meet the special needs of computational physics, while articulating with the University of Utah Computational Engineering and Science PhD degree certificate program.

2. SUPERVISION

The current Chair of the Computational Physics Committee is Professor Carleton DeTar. He counsels students interested in this degree option and approves Master's supervisory committee membership.

3. PROCEDURE FOR ADMISSION TO PROGRAM

Any student admitted for graduate study in Physics may enroll in the program.

4. COURSE REQUIREMENTS

A total of 30 credits is required, of which 6-10 are related to the computational project.

Core courses (12 hours)

PHYS 5010, 5020 required unless a student has a strong undergraduate preparation.
PHYS 6720, 6730 Computational Physics

Specialization courses (3 hours minimum)

An introductory course in the specific area chosen for the computational project

Computational Science Electives (6 hours minimum)

Computer Interfacing	PHYS 6620 (3)
Mathematical Modeling	MATH 5740 (3)
Case Studies in Computational Engineering & Science	MATH 6790 (3)
Seminar in Computational Engineering and Science	MATH 6795 (3) OR CP SC 6938 (3)
Software Practice	CP SC 5010 (3)
Algorithms and Data Structures	CP SC 5020 (3)
Scientific Visualization	CP SC 5630 (3)
Parallel Numerical Methods	MATH 5660 (4)
Advanced Scientific Computing I	CP SC 6220 (3)

Computational Physics Project PHYCS 6970 (6 - 10 hours)

Medical Physics Ph.D. Program

1. General Program

The medical physics program is designed to give an appropriate education to physics Ph.D. students desiring to specialize in some branch of medical physics. This program provides students with a solid physics background (through core and elective courses), but still allows enough flexibility for students to perform research in medical and other interdisciplinary areas (through elective courses in these areas). The research is normally supervised jointly by faculty from the Physics Department and from Medical Departments.

Areas of current research in medical physics in the Physics Department include MRI with hyperpolarized noble gases (Prof. Saam), biomedical optics and materials research for medical and laser applications (Prof. Gellermann). Professors Symko and Vardeny also have some connection in their research interests in medical physics. More details about these and other research programs can be found on the Medical Physics website (http:/www.physics.utah.edu/research/medical.html).

2. Supervision

The current Chairman of the Medical Physics Committee is Prof. David Ailion, in the Department of Physics, and he will approve Ph.D. supervisory committees.

3. Procedure for Admission to Program

To apply for admission and/or financial aid, a student should have a B.S. or B.A. with a major in physics. He/she should apply to the Department of Physics, but should specify a desire to specialize in medical physics. Admission requirements are the same as for the regular physics Ph.D.

4. Requirements for the Ph.D.

The general requirements are similar to those for a regular Ph.D. in physics, and require passing the Common Examination, the Ph.D. Qualifying Examination, and the Final Oral Examination (Thesis Defense). After a student has passed the Common Examination, he/she will request a Supervisory Committee which will monitor his/her progress towards the Ph.D. This committee will normally consist of five faculty members, including at least three tenured or tenure-track faculty members from the Department of Physics. The Chairperson of this committee will be a faculty member from the Department of Physics, but is not necessarily the student's thesis supervisor.

The course requirements for a Ph.D. in medical physics consist of 40 semester hours. These include required core courses (18 semester hours) in physics and elective courses (22 semester hours) in physics and other disciplines. The core courses for a medical physics specialty are:

Graduate Laboratory	(3)
Mathematical Methods I	(4)
Electrodynamics I	(4)
Quantum Theory I	(3)

PLUS two of the following courses:

Mathematical Methods II	(4)
Electrodynamics II	(4)
Quantum Theory II	(3)
Statistical Mechanics	(3)

Other courses in the Physics Department may serve as elective courses. Recommendations for Elective courses from OUTSIDE Physics that can be used to satisfy requirements for the Medical Physics PhD, with credit hours in parentheses. This list is not meant to be exhaustive but to provide typical examples. Specific courses can be decided upon with the help of the student's graduate counselor and/or PhD committee.

Physiology (PHYSL) 5200: Principles of Physiology (5)
Physiology (PHYSL) 6050: General Physiology (2)

Bioengineering (BIOEN) 5401: Medical Imaging Systems (3)
Radiology (RDLGY) 7310: Advanced Magnetic Resonance Imaging
Radiology (RDLGY) 7320: 3D Reconstruction Techniques in Medical Imaging

The course of study, including elective courses, should be selected after consultation with the student's Supervisory Committee or, in the case of a beginning student, after consultation with faculty members most closely associated with the student's likely field of specialization. The student's Supervisory Committee is to approve the student's course of study, including required or elective courses. Any exceptions to the above requirements must be approved by the Supervisory Committee, the Chair of the Medical Physics Committee, and the Physics Department's Director of Graduate Studies.

Physics Education Ph.D. Program

The Department of Physics is involved in research and development activities in Physics Education. A Ph.D. candidate seriously interested in the teaching of physics and in the research underpinnings of that teaching may wish to undertake a thesis topic in physics education leading toward a Ph.D. in Physics. Such students must meet all the requirements in the section entitled "Program for Ph.D. Candidates". The only differences between the program in Physics Education and those of candidates electing a traditional program in a research specialty in Physics shall be the nature of the thesis topic and the election of course work beyond the required "core" of graduate courses in Physics.

A number of faculty members in Physics are willing to assume responsibility for supervising thesis research in this area. These individuals may be contacted by students when exploring possibilities for research in Physics Education. Potential topics for research change as faculty interests and involvement in funded educational projects change.

Other Educational Opportunities

1. Interaction With Other Physicists

Graduate students are expected to attend departmental colloquia on a variety of general subjects and some departmental seminars on specialized topics in order to be aware of current developments. Although a beginning graduate student may find many of these seminars difficult to understand at first, he or she will find that they will aid in developing a vocabulary of concepts and terms that will provide the basis for better understanding later on. Graduate students are required to register for the Colloquium each semester for the first three years (PHYCS 6800 or 7800). Your grade for the Colloquium course is based on attendance only. You will not pass if you have more than three unexcused absences (only the faculty member in charge may determine if an absence is "excused"). Colloquia are held each Thursday at 4:00 p.m. in Room 102 JFB.

The student should also become acquainted with faculty members with whom he or she might like to become associated in research. They are available to guide a student in the choice of courses, as well as in the independent study of current literature. The Physics Department web site also has links describing faculty research interests and research opportunities for Master's and Ph.D. students.

Finally, advanced graduate students are particularly sympathetic to the point of view of a new graduate student, and can offer insight not otherwise available. The GSAC website www.physics.utah.edu/~gsac is a good place to find additional information regarding GSAC and the "Unofficial Grad Student Guide" link.

A faculty research seminar is typically held each spring semester and is intended to familiarize graduate students with current research and make them aware of summer research opportunities.

2. The Physics Department Reading Room

Various journals and books covering both elementary and advanced subjects are available in the Graduate Reading Room 212 JFB and in the Marriott Library.

Graduate students are given outside door entry codes. It is the present policy of the Physics Department to allow all students access to the Physics Reading Room. The room is a good place for studying (the Reading room book collection contains over 1,000 physics titles as well as a small collection of physics journals) and researching publications (there are currently 7 computers which provide access to online library catalog and online articles via the Marriott Library web site). All books in the library, with the exception of textbooks and other specially labeled books, are available to be checked out by those associated with the Department of Physics (students, faculty, staff, etc.) for the space of one week.

Requirements for Teaching Assistantships,Teaching Fellowships, and Research Assistantships

The Physics Department has a number of assistantships and fellowships available to graduate students. Awards will be made generally to graduate students in good standing who are making substantial progress toward their degrees. Ph.D. candidates are required to establish supervisory committees as soon as they pass the Common Examination. Master degree candidates should establish supervisory committees at the end of the first year of study. Students are encouraged early on to find out what research is being done in the department and to find research advisors as soon as possible. The three types of financial aid are described below:

TEACHING ASSISTANTSHIPS

These assistantships are awarded to students in good standing generally for a maximum duration of two years to Ph.D. candidates and one year to Masters degree candidates. The maximum duration applies to students who change from Ph.D. to master standing and vice versa. Since these assistantships are offered by the department to provide teaching support, it is expected that all recipients will have mastered spoken English and communication skills. To maintain support after the second year, each semester the TA must have the chair of his or her Supervisory Committee write a letter to the Director of Graduate Studies requesting support, enumerating progress toward the degree since the previous semester.

The Physics Department faculty has approved several changes in the awarding of Departmental Teaching Assistantships. A new, higher level of Teaching Assistantships with higher pay has been added to the traditional Teaching Assistantship, and the procedure for awarding Teaching Assistantships to advanced graduate students has been clarified.

Level-1 TA (Graduate Assistant)

Same pay and responsibilities as the traditional Teaching Assistantship. To maintain this position, students must take a minimum of 9 semester graduate credit hours of graduate-program-related courses.

Level-2 TA (Teaching Assistant)

Students who demonstrate excellent teaching performance, (passes TSE/SPEAK test with score ∃50 and completes ITA Workshop for ITA Students) while maintaining excellent academic standing in their graduate programs (while taking a minimum of 9 credit hours of graduate-program-related courses) are encouraged to apply for a TA position. Pay for this position will exceed that of the Level-l TA by approximately 18%.

Applications for this position will be accepted along with applications to Graduate School. Awards will be made for the rest of the academic year, though subject to revocation upon poor teaching or academic performance.

Graduate students must be registered for 9-12 hours of 5000 or above level courses to be considered full time and eligible for tuition benefits. Tuition benefits do not cover courses numbered 4999 or below, nor do tuition benefits cover lab fees or international student fees. A student must maintain a 3.0 GPA or above to be eligible for tuition benefits.

TEACHING FELLOWSHIPS

There are a limited number of teaching fellowships available. Graduate students may apply for these fellowships through their research advisor. Only students who have passed the Common Examination, established a supervisory committee, demonstrated good teaching skills, and shown progress toward the degree will be considered for these awards. The Teaching Fellowships could be renewed for a second year. Students receiving the stipend will be expected to perform teaching duties as with the teaching assistantship.

RESEARCH ASSISTANTSHIPS

These assistantships are awarded by faculty members who have active research projects. Recipients are expected to do work on the research projects which provide the assistantships. The arrangements for awarding and renewing research assistantships are made directly with the professor who has the funding. Assistantships are typically given only to those students who have passed the Common Examination and have established a supervisory committee. The length of the research assistantship is an agreement between the student and the faculty member with the funding.

SUMMER ASSISTANTSHIPS

A few summer assistantships are available. Summer assistance is very limited and will be given to those students who best demonstrate good teaching skills and are at a Level II TA.

EVALUATION OF PERFORMANCE

The performance and progress of teaching fellows and teaching assistants will be reviewed annually. In addition to satisfactory performance of teaching duties, teaching fellows must be making satisfactory progress in their academic program. When English is not the student's native language, this will include satisfactory progress in mastering English.

Normally a first year Physics graduate student will be taking at least two of the "core" graduate courses (7740, 7750, 7110, 7120, 7220, and 7230). When that is the case, a normal load will be at least two courses, plus the Colloquium. The Physics Department recognizes 11 (RA) or 12 (TA) credit hours as "full time." Additional 7910 hours will be taken to fill the maximum credit hours allowed by tuition waiver. The professor the TA is assigned to will teach the section of 7910. Courses that do not contribute to the student's progress, such as Physical Education, do not count, although they may be taken. English as a Second Language cannot count as one of these two courses. In order to receive tuition benefits, a graduate student must be registered for at least 9 hours of graduate credit. Tuition benefits will not cover classes below 5000 level and will not cover recreation classes. A student who takes less than two graduate core courses in his/her first year will be considered remedial. A remedial student must successfully take at least three courses (typically 4410, 4420, 5450, 5460, mathematics, and/or one core course) to retain departmental support. A student cannot be on remedial status for more than one year and retain a TA/TF without special permission. Full time instrumentation students will take 3 courses, as defined in the instrumentation program, to maintain normal progress and their TA/TF.

If a student is not successful in his/her academic program, his/her teaching assistantship may be terminated. The student may retain support by entering into a written agreement with the graduate advisor specifying courses to be taken, and grades to be achieved. This will be reviewed each semester, and the support will be terminated if the terms of agreement are not met.

Occasionally the Physics Department may have teaching needs that will lead to the temporary waiving of the above rules. Usually this will only occur if the student has special teaching skills that are particularly needed. If this occurs, it does not mean that the rules above have been canceled for that student or any other student.

A student's graduate committee may request that the department waive these rules if some clearly special circumstances exist.

Physics Graduate Assistants (GA) and Teaching Assistants (TA) Responsibilities

INTRODUCTION

This section is intended to outline departmental procedures regarding Teaching and Graduate Assistants. It covers assignment procedures, job disciplines.

1. TEACHING ASSIGNMENTS AND LOADS

There are three different positions from which the teaching personnel are drawn. These are regular faculty (including Assistant, Associate, and Full Professors), Post-Doctoral Fellows, and Graduate Teaching Assistants. This section deals with the latter two categories.

(a) Postdoctoral Fellows

Many of the department's Postdoctoral Fellows or Research Associates have a part of their salary paid by the department. They are responsible to the department for a fraction of their time equal to the fraction of their salary provided by the department. In the usual case the department provides 30% of the salary. This case will be discussed here. In other cases the obligation to the department is in proportion to this fraction.

A standard load per semester is either: (1) responsibility for one course; or (2) 20 hours per week. It is expected that this load will be maintained for 2 semesters with the summer semester devoted to the research group. However, enrollment contingencies may force changes in this policy.

(b) Teaching Assistants (TA) and Graduate Assistants (GA)

See pp. 18-20. A standard TA or GA load is 20 hours per week. TA's and GA's are typically awarded for two semesters and the load is maintained for two semesters. Enrollment contingencies may make it necessary to trade overloads in one semester for light loads in another. In other words, the standard TA/GA load is actually no more than 20 hours per week averaged over two semesters.

Graduate Assistants are Level I Teaching Assistants who have not met the University communication skill requirements. TA's are Level II Teaching Assistants capable of teaching a discussion section.

(c) TA and GA Loads

Some jobs are common enough to have preassigned values, whereas some must be evaluated as they arise. The following is a table of typical preassigned workload values:

Job	Hours/Week
2 Discussion Sections 2010 or 2110 Series	20
2 Discussion Sections 2210 Series	20
1 Lab Section 2019, 2029 Series	7 (10 first semester teaching lab)
1 Lab Section 2219, 2229 Series	7 (10 first semester teaching lab)
Grading	1-20 (depends on course level and enrollment)

The above unit values are for Fall and Spring semesters. In the Summer semester, the typical values are: (This may even fluctuate some due to varying SCH values and budgetary constraints.)

Job	Hours/Week
1 Discussion Section 2010 or 2210 Series	10
Grading	Hours depend on course level and enrollment

The workload value for the other jobs is determined case by case, for example, for the job of Grader for the various advanced classes and Grader for 1010 sections. The general guidelines are as follows:

I. A Grader is assigned to any instructor of a class other than a discussion section whose enrollment warrants assistance.

II. The work load value for a given assignment is based on the time it should take to do the job (as judged by experienced TA's who have previously read for the particular course). Note that the assignment is made on the basis of how long it should take, not how long it actually does take.

Finally, it should be noted that Lab instructors are usually expected to do their own grading.

2. JOB DESCRIPTIONS, QUALIFICATIONS, AND EVALUATIONS

(a) Instructors of Discussion Sections (2010, 2020, 2110, 2120, 2210, 2220)

I. The Job: The Instructor meets with the discussion section twice weekly to provide help with assigned problems and with questions which arise concerning the course. He or she grades exams and helps proctor them. Attendance at lecture is required. Personal involvement with students (dating, tutoring for pay, etc.) in one's discussion section is forbidden. Each instructor should schedule approximately three hours per week for consultation with students.

II. Qualifications: The Instructor must be able to speak English well, must have passed the SPEAK test, must be conscientious about preparing for class, must be reliable in attendance, and must be willing to help students on an individual basis where necessary. It is highly recommended that the TA attend the lecture (at least the first time through the course).

III. Criteria for Assignment and Retention: Student ratings on university or departmental evaluations and recommendation of **the instructor in charge of the** course form the basis for assignments and retention.

(b) Lab Instructors (2015, 2025, 2215, 2225)

I. The Job: The class meets once a week, for a three-hour period of investigation in the laboratory. The instructor's responsibilities in the laboratory are (a) to motivate the students towards independent thinking in applying physical principles to experimental problems; (b) to teach experimental techniques; (c) to instruct the students in the care and use of equipment; and (d) to solve simple malfunction problems with the equipment. The instructor is required to attend scheduled meetings of laboratory instructors and must become familiar with the equipment and the experimental procedures prior to the laboratory class. *The instructor is to remain in the laboratory during the time the students are performing the experiments*. In case an instructor is unable to attend class, he or she is expected to find a substitute. The instructor grades the students homework and lab reports and must keep a record of these grades.

II. Qualifications: The instructor must be able to communicate effectively, must be conscientious in helping the students in both an individual and a group basis, and must have some prior knowledge of experimental equipment, experimental techniques and safety lab.

III. Criteria for Assignment and Retention: Student ratings on University and departmental evaluations and an appraisal by the laboratory supervisor concerning attitude, accomplishments, and ability form the basis for assignments and retention.

(c) Graders

I. The Job: Graders are assigned to a lecturer (professor in charge of a course) to grade homework, quizzes, and/or exam. At the request of the lecturer, a grader answers student's questions about problems.

II.Qualifications: Language fluency is less important in this job. The grader should have completed the next higher level course sequence (than the course being graded) with at least a B+ grade.

III.Criteria for Assignment and Retention: The recommendation of the lecturer provides the basis for assignments and retention.

The above job descriptions apply to Fall and Spring semesters. In Summer Semester, some of the discussion sections meet on a different schedule; thus the teaching loads are different. **Information about loads** is available at the time TA applications for Summer Semester are received.

3. EVALUATIONS, PENALTIES

(a) Ratings of Personnel

Ratings of each GA, TA and Postdoctoral Instructor are based upon the student evaluations, by personal observation of their classes, and by individual student comments. These evaluations are available in the office, but are not included in public reports.

(b) Penalties

In most cases of negligence, a verbal reprimand suffices. More severe cases may require more severe action, including termination or non-renewal of assistantship. Such cases will be considered by the Department Policy Board, which will then take appropriate action.

TA Assignment Procedures and Considerations

(Revised 13 November 2007)

Teaching assignments in the Physics Department typically fall into four main categories:

1. Discussion sections for large courses (2010, 2010, 2110, 2120, 2210 and 2220)
2. Upper level lab assistants (3410, 3610 and 3719)
3. Elementary lab assistants (1890, 2015, 2025, 2215 and 2222)
4. Grading for undergraduate courses

These assignments are listed in the order of communication skills required to fill the assignment. Discussion TA's need the highest communication skill set since they have four hours of student contact each week. They need to be able to speak clearly, understand questions students ask, and explain physics problems with clarity and accuracy. TA's for upper level lab courses require the same communication skills and need a deeper understanding of the course material. Elementary lab TA's need a high level of communication skills, but typically meet students on a one-on-one basis. The ten minute introduction requires good communication skills.
Grading requires the least communication skills unless the instructor requires the TA to conduct a discussion section for the course.

There are many factors that go into making a TA assignment. Some of the most important issues are listed in approximately the order of importance:

- A list of possible TA's is shown to the faculty members who will teach the large lecture courses, and the instructors are asked to give approval of the TA's who are planned for the course. Faculty input is taken very seriously, and every attempt is made to make certain that faculty are happy with the list of TA's. This is especially true when the marshal is being selected. (Most of the time the faculty member will request a specific marshal).
- The prospective discussion TA list is reviewed with staff members who have worked with the individual TA's in prior semesters. This input is weighed and considered. Student evaluations of TA's are reviewed to make certain all is in order.
- Many faculty have requests for specific graders, lab assistants, discussion leaders and marshals. These requests are factored in and granted when possible.
- New TA's are surveyed during the orientation and asked to list the assignments they would prefer. These requests are granted when possible.
- Discussion assignments for the large lecture courses are made first.
- Lab assistant assignments are assigned next.
- Finally the grading assignments are made.
- There are always one or two special need assignments that require special considerations (3730 TA, one time course offering TA, etc.)
- Always at the last minute a TA will have an assignment and then finds and RA. This requires a reshuffling of assignments - sometimes requiring extensive reassignments.
- TA performance will be considered in making TA assignments. Typically outstanding performance will most likely result in that TA becoming marshal in the near future. Bad performance should lead to dismissal but to this point in time has resulted in a reassignment of duties for future semesters.
- In the future we will send out a notice to Tas for spring semester and fall semester to have them respond and request the assignment they desire for that semester. <u>These requests obviously cannot be guaranteed, however whenever possible they will be honored.</u>

The goals Lynn strives for when making TA assignments are listed in order of importance:

- The assignments are fair. Each TA should be given an assignment. that requires approximately 20/week. This is spelled out on the final TA Assignment list, and the faculty know exactly how many hours each TA has been assigned.
- The assignments will provide the best instruction for the students. The students deserve the best TA's we can provide in each position.
- Faculty are happy with the TA's who have been assigned to them.
- TA ability a skill set is matched to the TA assignment
- TA's feel they have been treated fairly.

In order to achieve these goals there has always been fine tuning in the assignments after the first list is distributed. A sheet listing the assignments is distributed to all TAs with a note telling them to contact the one making the assignments if there is a problem with the assignment. Faculty or TA marshals often give input that additional help is needed or that a certain TA neesd to be shifted to another assignment, etc., etc.

Additional comments:

- Level I TAs are not given responsibility in the labs or discussions. These students have not passed the SPEAK Test requirements imposed by the University of Utah.
- Level II TAs are given any assignment since they have passed the SPEAK Test. They are paid at a higher rate. These are the only students considered for a summer TA since the summer assignments are so scarce and limited.
- A full TA for 20 hours/week is normally one of the following:
  I. 2 discussion sections
  II. 3 labs (2 the first time teaching labs)
  III. Grading 1 or 2 courses depending on enrollment & how the instructor uses the grader.
  IV. Miscellaneous (rare) special assignments.
- The minimum requirement for continuing graduate students as a TA for the third and subsequent years is a letter from the chair of his/her Supervisory Committee stating that the student is:
  I. Making satisfactory progress toward the degree,
  II. A statement explaining why there is no funding available for an RA
  III. The expected date of graduation.