EXAMINATION REQUIREMENTS FOR THE PhD PROGRAM

Summary of Requirements:

Graduate Written Examination: Must pass by the end of the fifth semester.

Graduate Thesis Committee: Must be formed at least one semester before taking the Oral Comprehensive Examination.

Oral Comprehensive Examination: Ph.D. candidates must pass by the end of their seventh semester.

Thesis Defense: Must be passed within five years of passing the Oral Comprehensive Examination.

Program Details:

Graduate Written Examination:

Every student entering the PhD program, with or without a Master’s degree, must take and pass the Graduate Written Examination. The exam is given once each year a few days before the start of Fall Semester classes. The actual date on which the exam will be given is fixed in April by the Physics Graduate Faculty. The criterion for passing the examination is to demonstrate a strong, usable knowledge of undergraduate physics at a level similar to the one taught to undergraduates at the University of Maine. To pass, students should expect to demonstrate a broad range of knowledge of classical dynamics, electricity and magnetism, thermal and statistical physics, and quantum mechanics. Students are expected to be able to apply their knowledge to solving explicit problems in several of these areas. In addition, students are expected to have some general knowledge about physics specialty areas such as astrophysics, atomic physics, condensed matter physics, elementary particle physics, and nuclear physics. The required level of understanding in these latter subjects is mostly qualitative.

The nominal passing score is typically about 75 percent. The actual passing score for each year’s exam will vary somewhat from this nominal value and is determined by the Department’s Graduate Faculty.
Students entering the program are required to take the exam every time it is offered. All new students take the exam as a “free try” at the start of their first semester. The results may also be used by the Graduate Coordinator to help each student enroll in the most appropriate course sequence. Returning students must take the exam each time it is offered until they pass. After 2 fails (not counting the first attempt), a student will be removed from the PhD program. Students who pass the graduate written exam on the first “free” try satisfy the requirement and are not required to retake it. Students who do not pass are encouraged to seek feedback and study advice from their advisors, students who have passed the exam, and members of the Department’s Exam Committee.

Students who enter the program in the Spring Semester do not get the free try and take the exam the next time it is offered.

The exam has two parts.

**Part I** is comprised of about ten elementary level questions and counts one third of the total score. A total of two hours is allotted for this part. Each question is designed to require about 7 minutes for its solution. Questions are at the level of University of Maine introductory undergraduate courses PHY 121/122 and PHY 236. The topics are mechanics, thermodynamics, kinetic theory, waves, electromagnetism, electrical circuits, light and optics, and elementary modern physics. Representative elementary physics texts are *Physics for Scientists and Engineers* (Knight) and *Concepts of Modern Physics* (Beiser).

**Part II** is comprised of a choice of 10 out of 15 questions and counts two thirds of the total score. A total of four hours is allotted for this part. Each question is designed to require about 12 minutes for its solution. Questions are at the level of University of Maine upper level undergraduate courses PHY 229/230, PHY 223, PHY 238, PHY 441/442, 454/455, PHY 462/463, PHY 469, and PHY 472. About ten Part II questions concern core topics: classical mechanics (motion in electromagnetic and gravitational fields, rigid bodies, coupled oscillations, and continuum vibrations), electricity and magnetism (statics, fields in matter, Maxwell’s equations, optics and radiation), thermal physics (thermodynamics and statistical mechanics of matter and radiation), and quantum mechanics (wave mechanics, angular momentum,
perturbation theory, atoms and molecules, and scattering). Representative core text books are

*Classical Mechanics* (Taylor), *Introduction to Electrodynamics* (Griffiths), *Thermal Physics* (Byerlin), *Art of Experimental Physics* (Preston & Dietz), and *Quantum Physics* (Griffiths).

Additional questions may concern light and optics at the level of *Optics* (Pedrotti et al.), special relativity, nuclear/particle physics, plasma, solid state physics, and space physics encountered as applications in core courses, and laboratory techniques including error analysis, instrumentation, circuits and electronics. Students are encouraged to consult their advisors on how to best prepare for the exam. Copies of all previous exams will be available on the Department’s website.

Outside reading, auditing of undergraduate courses, and group problem solving sessions are typical strategies for students requiring additional preparation. Students with special requirements must consult with the Graduate Student Coordinator at least two weeks prior to the exam date.

The Graduate Written Examination is administered by the Graduate Examination Committee. It consists of a rotating group of 3 faculty members. The sole responsibility of this Committee is the preparation and grading of the Graduate Written Examination. The Committee solicits problems on specific topics from the faculty. Committee members work, edit, and select the exam problems, and are available during the exam to address any questions. The examination is graded without knowledge of the name of the examinee. The Written Examination Committee compiles the grades and makes recommendations concerning passing to the Physics Graduate Faculty. Graded exams are returned to the students.

Extensions or variations to the timetable described above may be granted by the Physics Graduate Faculty only in exceptional hardship cases such as extended illness, leaves of absence, etc.

**Oral Comprehensive Exam**

The Oral Comprehensive Examination is the second major examination. Students entering the PhD program with a BA or BS degree must pass the oral exam by the end of their seventh semester. Students entering with an MS degree must attempt the exam prior to the start of their 4th semester.
Students must form a Graduate Thesis Committee and have a program of study (POS) on file no later than their second semester. These events must precede the oral exam by at least one semester. Initially, this committee must have at least 3 members (at least 2 of these must be faculty from the Physics Department) including the thesis advisor. The Graduate School requires a membership of 5 faculty at the time of the Thesis Defense (see below). The student, in consultation with the committee, must submit a Program of Study to the Graduate Coordinator.

The student must formally make a request to the Department Chair to schedule the Oral Defense. The Department chair will establish an Oral Comprehensive Examination Committee for the candidate prior to the Oral Comprehensive Examination. This Committee has the responsibility of administering the Oral Examination. The committee will consist of four faculty members from the Department of Physics & Astronomy. In cases where the candidate’s thesis advisor is from outside the Department, the advisor may serve as a non-voting member of the committee. Two of the physics faculty must be from the candidate’s Graduate Thesis Committee and the other two will be appointed by the Chair (rotated through the Department’s faculty and not from the same sub-area of physics as the proposed thesis research).

Prior to the Oral Examination, the candidate will prepare a written thesis proposal that emphasizes the physics content of the thesis project. This proposal is submitted to both the Graduate Thesis Committee and the candidate’s Oral Comprehensive Examination Committee at least 2 weeks before the oral exam can be scheduled. The proposal cannot exceed 15 pages. The format must follow that of the Project Summary and Project Description sections of an NSF proposal (http://www.nsf.gov/pubs/policydocs/pappguide/nsf11001/gpg_index.jsp). Upon submission of the thesis proposal, the candidate will also provide each of the Comprehensive Oral Examination Committee members with complete copies of 5 publications that the candidate believes are the 5 most important papers relevant to the proposed thesis topic.

The oral comprehensive exam will consist of a 30-minute public seminar given by the candidate that focuses on the thesis topic. The presentation will be followed by a question and answer period of up to 20 minutes which will include questions from the audience. The time limits will be strictly enforced. This will be followed by a closed-door oral questioning of the student by the Oral Comprehensive Examination Committee. The closed-door session may not last longer
than 50 minutes and normally begins with questions closely related to the physics content of the seminar. The goal of the questions is to determine if the student’s depth of knowledge of physics is adequate for the proposed thesis research. Thus, sequences of questions may cover a diverse range of topics in physics as deemed appropriate to the thesis topic by the Oral Comprehensive Examination Committee.

The pass/fail decision will be made by the Oral Comprehensive Examination Committee (i.e., by the four members from the Physics Department). If desired, other Graduate Thesis Committee members may participate in the closed-door questioning but they will have no vote. Three positive votes are required for the student to pass. If the student fails, the Comprehensive Oral Examination Committee can recommend that the student may retake the oral exam, but only for a second and final time. Any retake must occur within three months of the initial oral exam. The Committee may also recommend that a student who fails the examination be allowed to finish a Master’s Degree by the end of the following semester. The student is responsible for forming the Graduate Thesis Committee and scheduling the oral exam, including posting of announcements at least one week prior to the presentation.

Extensions or variations to the Oral Comprehensive Examination timetable described above may be granted by the Physics Graduate Faculty only in exceptional hardship cases such as extended illness, leaves of absence, etc.

**Thesis Defense**

The final examination is an oral defense of the thesis, and must be completed within five years of passing the Oral Comprehensive Examination. The current requirements for this examination are unchanged by this document. The Graduate School requires the following:

After the doctoral dissertation has been accepted by the candidate’s advisory committee, the original copy shall be presented to the Graduate School. The candidate must then appear for final examination by an examining committee of no fewer than five members (usually the student’s advisory committee) appointed by the Dean of the Graduate School upon recommendation of the major advisor. Other members of the faculty may attend and participate in the questioning, but only members of the committee may evaluate the student’s performance.
The final examination, which is oral, is concerned with the subject of the dissertation and with the candidate’s understanding of related matters important to a proficiency in the principal field of study. The examination must demonstrate the candidate’s mastery of the techniques of research and skill in organizing and presenting the material.

**Typical Time Line** (Fall enrollment):

<table>
<thead>
<tr>
<th>Semester</th>
<th>Event</th>
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<tbody>
<tr>
<td>Semester 1</td>
<td>Take “free try” Written Exam</td>
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<tr>
<td>Semester 1</td>
<td>Visit 5 faculty/</td>
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<tr>
<td>Semester 2 (4/15)</td>
<td>Form Graduate Thesis Committee</td>
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<td>Semester 2 (4/15)</td>
<td>Establish Program of Study</td>
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<td>Semester 2 (4/15)</td>
<td>Summer research proposal</td>
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<td>Summer 1</td>
<td>Begin working in research group</td>
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<tr>
<td>Semester 3</td>
<td>Pass Written Exam</td>
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<tr>
<td>Semester 5</td>
<td>Oral Comprehensive Exam</td>
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<tr>
<td>Semester 9-10</td>
<td>Thesis Defense</td>
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