

**DEPARTMENT OF PHYSICS AND ASTRONOMY REGULATIONS
FOR THE M.Sc. AND Ph.D. PROGRAMS
SUPPLEMENTARY TO THE REGULATIONS OF
THE FACULTY OF GRADUATE STUDIES**

(Effective September 2005)

The Department of Physics and Astronomy is generally able to provide financial support to all graduate students who maintain satisfactory progress in their degree program. Students are normally expected to complete the M.Sc. Program within 2 years and the Ph.D. degree within 5 years.

Graduate students wishing to develop their teaching skills and improve their grasp of elementary concepts may apply for teaching assistantships in the Department of Physics and Astronomy. Students will be remunerated by the Department for such activities at the current approved rate set by the University of Manitoba.

In addition to the regulations, policies and practices required by the Faculty of Graduate Studies for students in the M.Sc. and the Ph.D. programs described in the General Calendar, the Department of Physics and Astronomy has certain supplementary regulations. The minimum requirements are described below for the M.Sc., the M.Sc. in Medical and Health Physics, and Ph.D. degrees. The appropriate program will be determined for each student by the M.Sc. advisor and/or the Ph.D. advisory committee, in consultation with the Head.

Inclusion of published papers in M.Sc. and Ph.D. theses:

Published peer-reviewed papers within the master's and doctoral theses are permitted provided they conform to the following:

- i. In case of multiple-authored papers, the candidate's specific contribution to each paper must be clearly indicated.
- ii. A separate abstract, full introduction, and conclusions, must be included.
- iii. Where more than one manuscript is included, connecting text and common abstracts, introduction, and conclusions must be included. The full text and graphics of the final manuscript of the published papers should be reformatted in the style of the thesis and included as separate chapters so that the thesis appears as a coherent document.
- iv. There must be adherence to all other requirements as outlined in Thesis Guidelines of the Faculty of Graduate Studies.

SUPPLEMENTARY REGULATIONS FOR THE M.Sc. PROGRAM

Student's Advisor and Program: Each M.Sc. student must have an Advisor (who is a member of the Faculty of Graduate Studies) whose responsibility is to advise the student on a course program, direct research, and supervise thesis work. The course program is approved by the Department Head, in consultation with the student's advisor.

In the event that an M.Sc. student's progress is judged by the Advisor to be unsatisfactory, the Advisor will request that the Department Head strike a review committee which will conduct a review of the student's progress.

Minimum Course and Grade Requirements: The Department requires a minimum of 12 credit hours of course work, normally at the 700 level. Substitution of some upper year undergraduate courses may be permitted, provided that there are at least 6 credit hours at the 700 level in the major subject. The undergraduate courses may be at the 400 or 300 level, and may be chosen from outside the Department. They must be relevant to the thesis work. A minimum grade of C+ is required in each course.

M.Sc. Thesis: An oral defence of the thesis is required for all students registering in the regular M.Sc. program. There are no comprehensive examinations in the regular M.Sc. program. The examining committee will consist of at least 3 members of the Faculty of Graduate Studies, including the student's advisor, a faculty member of the Department of Physics and Astronomy, and one person from outside the Department of Physics and Astronomy. The oral examination shall be conducted by the thesis examining committee and shall normally be chaired by the student's advisor or by the Department Head or his/her designate. The oral examination is open to Faculty, Research Associates, Postdoctoral Fellows and Graduate Students of the Department of Physics and Astronomy. The first part of the oral examination consists of a statement by the candidate covering the salient points of the thesis work and normally is limited to approximately 20 minutes. This presentation is followed by questioning and examination of the candidate by the examining committee. The examiners will signify the acceptance of the thesis or practicum by signing the "Report on the Master's Thesis" form. Formal approval of the thesis is to include both the text of the thesis as well as satisfactory performance on the thesis defence. Acceptance must be unanimous.

SUPPLEMENTARY REGULATIONS FOR THE Ph.D. PROGRAM

Students normally enter the Ph.D. program from the University of Manitoba M.Sc. program. Occasionally, advanced students holding the equivalent of the University of Manitoba M.Sc. degree may be admitted directly into the Ph.D. program. M.Sc. students at the University of Manitoba may also transfer directly into the Ph.D. program without completing the M.Sc. degree; these students must obtain approval from the Graduate Studies Committee. The general requirements for granting such a transfer are that a student must have an honours B.Sc. degree from the University of Manitoba (or have an equivalent degree), must show a capacity for independent, original research and must have his/her Advisor's approval. In addition, students who have not completed an M.Sc. degree must have obtained a minimum GPA of 3.00 in their current M.Sc. program.

International students are **strongly** encouraged to write the GRE physics subject examination prior to applying for the Ph.D. program.

Student's Advisor and Advisory Committee: Each student must have an Advisor (who is a member of the Faculty of Graduate Studies) whose responsibility is to advise the student on a program of study, direct research and supervise the thesis work. The Head of the Department is responsible for appointing the student's Advisory Committee. This committee consists of a minimum of four members, one of whom is from outside the Department of Physics and Astronomy, and one of whom must be a faculty member of the Department of Physics and Astronomy. The Advisory Committee also includes the student's Advisor as the chairperson. The Advisory Committee has the responsibility of providing advice to the student on research and other matters.

Annual Reviews: The Advisory Committee is required to carry out an annual review of the student's progress in time to file a report to the Faculty of Graduate Studies (through the Department Head) by May 30 of each year. A student whose performance is unsatisfactory may be required to withdraw from the PhD program. The review begins with a 30-minute oral presentation given by the student followed by a period of questioning by the advisory committee. Following this, the relevant form is completed and signed by the committee members and the student.

Minimum Course and Grade Requirement: A minimum of 24 credit hours of work past the Honours Bachelor level is required. Of these, a minimum of 18 credit hours must be at the 700 level. Normally, 12 credit hours are taken for the M.Sc. degree and an additional 12 credit hours

are then required for the Ph.D. degree. A minimum grade of C+ in each course and a minimum cumulative grade point average of 3.0 are required by the Faculty of Graduate Studies for continuance in the Ph.D. program. The Graduate Calendar provides full details on the implications of transferring directly from the M.Sc. to the Ph.D. program and also describes how credit may be transferred for courses taken outside the University of Manitoba.

The student's course program shall be selected in consultation with and subject to the approval of the student's Advisory Committee. All Ph.D. students are required to take 16.7xx Quantum Mechanics I (3).¹ In addition, all Ph.D. students are required to take a minimum of 6 credit hours from the list below, with the exception of Ph.D. students specializing in medical physics, who are required to take 16.736 Medical Radiation Physics (3) plus a minimum of 3 credit hours from the list below:

- 16.754 Statistical Mechanics (3)
- 16.755 Advanced Statistical Mechanics (3)
- 16.759 Electromagnetic Theory (3)
- 16.760 Applied Electromagnetism (3)

In cases where the student has already taken the above or equivalent courses prior to entering the Ph.D. program, or in other special cases, other courses shall be substituted, upon recommendation of the student's Advisory Committee and with approval of the Department Head.

Candidacy Examination: The purpose of the Candidacy Examination is to test the student's ability to carry out independent and original research at the Ph.D. level and to complete the degree in a timely manner. The student must take the formal Candidacy Examination within the first 18 months after entering the Ph.D. program. For students transferring from the M.Sc. program, the Candidacy Exam should be taken within 6 months after registering in the Ph.D. program. If a student is unsuccessful in the first attempt, a second attempt shall be allowed, within no more than 6 months of the first. Only two attempts will be allowed.

¹ Note -- These regulations are effective as of September, 2005, but the new half course 16.7xx "Quantum Mechanics I", will not be available until the 2006-7 academic year. Students are advised that in 2005-06, the minimum 3 credit hours of quantum mechanics required for the Ph.D. program can be taken by registering in a special section of 16.744 (3) Advanced Topics in Physics -- "Topics in Quantum Mechanics".

In order to pass, the student is required to:

- 1) propose and defend an independent and original research project;
- 2) demonstrate his/her breadth and depth of basic knowledge relevant to the proposal;
- 3) demonstrate his/her ability to compose professional written and oral presentations in the proposed research area.

Format:

The student must prepare, submit, and defend a written research proposal. The written proposal may be prepared in either of the two following scenarios:

- a) If the student's thesis project has been established by the time of the examination, then his/her Ph.D. thesis project should be the subject of the written proposal;
- b) If the student's thesis project is not fully established at the time of the examination, then the written proposal should be based on the initial stages of investigation that will be carried out to develop a program of research for the Ph.D. thesis.

In **either** scenario, the written proposal must include:

- 1) an introduction and overview of the background material relevant to the proposed research, including the appropriate literature review;
- 2) a description of the research to be carried out, including the scientific motivation, methodology, and a plan for assessing the outcome.

The written proposal should typically be 5-8 pages in length, not to exceed a maximum of 12 pages, including all figures, tables and references. The text should be prepared in standard 12 pt type with single line spacing and 3/4 inch margins.

The written proposal must be submitted to the Examining Committee at least two weeks prior to the oral examination.

The oral examination shall consist of a 30-minute talk by the candidate, presenting and defending the written research proposal. The presentation will be followed by a question period during which the

committee shall examine the student's mastery of the presented material and of basic knowledge relevant to the proposed research area.

The Examining Committee (Candidacy Exam)

The Examining Committee shall consist of the student's Ph.D. Advisory Committee, supplemented by one additional faculty member from the Department of Physics and Astronomy in the role of Chair. The Graduate Studies Committee is responsible for appointing the Chair, who shall be a voting member of the Examining Committee, and who ideally has expertise in a closely related research area. The Chair is responsible for the conduct of the examination and for ensuring that the committee questions are fair and reasonable in light of the student's training and the content of the written proposal.

The Candidacy Exam is open to the Ph.D. candidate and the Examining Committee.

Committee Decision:

Following the question period, the candidate will withdraw, and the examiners will meet in private to determine the outcome of the examination. To be successful, the student must achieve a passing grade in both the written and oral components of the examination. The examiners shall assess a letter grade for the written proposal and a pass/fail grade for the oral examination. A passing letter grade for the written proposal shall be a grade of C+ or higher.

The overall committee decision to pass, or conditionally pass, must be unanimous. The decision shall fall into one of the three following categories:

1. Pass
2. Conditional Pass: the committee has identified deficiencies of a minor nature in the research proposal. A revised written proposal must be received by the Examining Committee within three months and must be deemed satisfactory by the committee in order to change the student's status to "Pass".
3. Fail: the student has not convinced the committee of his/her readiness to carry out independent and original research at the Ph.D. level and to complete the degree in a timely manner. The examiners shall provide a written assessment of both components of the examination, including comments to the

candidate noting any areas of concern arising from either the written or the oral presentations. The student will be required to correct deficiencies in both the research proposal and in his/her basic knowledge of subject areas that are directly relevant to the proposed research. The student must retake the Candidacy Examination, including the submission of a new or updated research proposal, within six months of the first attempt. No more than two attempts are allowed.

The student will be informed of the result by the Chair of the Examining Committee, who will also inform the Department Head, the Chair of the Graduate Studies Committee, and the Dean of Graduate Studies in writing of the result.

Thesis Examination and Defence: The examination of the thesis and its subsequent oral defence is carried out as prescribed by the regulations of the Faculty of Graduate Studies. The examining committee will consist of the student's Advisory Committee and one external examiner (from outside the University of Manitoba). The oral defence of the thesis is open to all members of the University community.

SUPPLEMENTARY REGULATIONS FOR THE M.Sc. MEDICAL AND HEALTH PHYSICS PROGRAM

This program is designed to prepare students for a career in Clinical Medical Physics and/or in Health Physics. This program, which requires a minimum of two years study (18 months course work, and at least 6 months research) has an increased load of **course work** (36 credits) of didactic and experimental/clinical courses. Research (e.g. 2 summers of 3 - 4 months) in an approved laboratory and the submission of a satisfactory **research report** are also required. On successful completion of the course work, the student will be required to pass a **comprehensive examination** that will cover the requirements for program accreditation.

Students will be accepted into the Medical and Health Physics M.Sc. Program by the Director of the Medical and Health Physics Graduate Program (on the recommendation of the Medical and Health Physics Graduate Program Committee and subject to the approval of the Department of Physics and Astronomy) rather than by an individual supervisor. An appropriate supervisor will be assigned by the Director of the Medical and Health Physics Graduate Program to oversee the student's research and will act as a mentor for the student. Note: Due to the clinical and professional nature of this program, students are

required to dress and conduct themselves in a manner which is appropriate to the Medical and Health Physics professions.

Course Work: The following courses are required: 016.736, 016.737, 016.738, 016.739, 016.740, 016.741, 016.746, 016.747, 016.757, 016.760 for a total of 30 credit hours. Students are required to obtain a minimum of 6 additional credit hours to be selected from the following: 016.744, 016.425, 016.454, 022.132, 022.133, and 16.759. Changes in this program will only be allowed with the prior written approval of the departmental Graduate Studies Committee. N.B. 016.770 (Research Project in Medical and Health Physics) is also required.

Research Project Proposal: The student shall submit a one-page proposal that outlines the nature and scope of the work to be undertaken. This proposal must be submitted within six months of initial registration in the Master's program. If the proposal is satisfactory to the student's supervisor and the Medical and Health Physics Graduate Program Committee, they will recommend its acceptance to the Head of the Department. If unsatisfactory, a final submission must be made within the next 3 months.

Annual Performance in Course Work and Project: The student's supervisor will evaluate the performance of the student's research. An annual progress report is made to the Faculty of Graduate Studies using the "Master's Annual Progress Report" signed and dated by the Director of the Medical and Health Physics graduate program after input from the advisor. If the performance of the student is unsatisfactory, the student will be required to withdraw from the Master's program and from the Faculty of Graduate Studies.

Research Project Report and Presentation (16.770): The research project report shall be submitted in a style and length as specified by the Department. The student should submit the project report to the examining committee members at least 3 weeks before the oral presentation at which the student will present and defend the findings presented in the report. The student is expected to present his/her findings in a 30 to 35 minute period, after which the chair will invite questions from all members of the examining committee and then the audience. The entire proceedings will normally not exceed 90 minutes in duration.

The examination committee must be approved by the Department Head and shall consist of the student's supervisor (who shall chair the committee), another member of the department with expertise in the field of study and one other faculty member normally either from another department at this university or an appropriate colleague from the professional community. (Unlike the M.Sc. thesis, it is not necessary to inform the Faculty of Graduate Studies of the project report title and the

names of the examining committee.) Based on the examining committee's comments and the candidate's performance at the oral presentation, a grade of Pass or Fail will be assigned. In the event of a Fail, a final submission may be made within 6 months. The student's supervisor is responsible for the completion of the form "Report on Medical and Health Physics Research Project and Report". After approval of the Project and Report and the completion of any revisions required by the committee, the candidate shall submit three copies of the final report to the supervisor who shall retain one copy, deposit one copy in the Medical Physics library, and deliver one copy to the Physics and Astronomy general office.

Comprehensive Examination: On satisfactory completion of the required course work and the research project (16.770), the student will be required to pass a Comprehensive Examination (69.701). The exam is designed to ensure that the student has an acceptable grasp of the discipline of Medical and Health Physics and the program meets the requirements for accreditation by the Commission on Accreditation of Medical Physics Educational Programs (CAMPEP). A syllabus of the material to be examined will be made available to the student and the examiners. By its very definition, the examination will examine the total knowledge gained by the student in the field of Medical and Health Physics rather than merely a recall of facts.

The examination committee must be approved by the Department Head and will consist of at least 4 members. The Director of the Medical and Health Physics Graduate Program will chair the committee, at least one of whom shall hold a Medical Physics certification recognized by the Canadian Organization of Medical Physicists, one of whom will have expertise in Radiotherapy Physics, one will have expertise in Imaging Physics and one in Health Physics. The examination will follow a multiple choice and/or an oral format and should not exceed 4 hours in total. The Medical and Health Physics Graduate Program Director will be responsible for the completion of the "Report on Master's Comprehensive Examination" which will reflect a passing or failing grade. The Comprehensive Examination may be repeated only once. Re-sitting will take place within one year, calculated from the date of the first examination concerned.