

Graduate Programs Information
Department of Physics and Engineering Physics

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1. Programs and Curricula

The department of Physics and Engineering Physics offers M.Sc. and Ph.D. programs in “Physics and Engineering Physics”. This document describes the programs regulations and requirements.

A four-year Bachelor of Science (B.Sc.) degree in physics, astronomy, or engineering physics from a recognized college or university is required for admission into an M.Sc. program. Additional requirements as per CGPS regulations apply.

A Master of Science (M.Sc.) or equivalent degree in physics or engineering physics from a recognized college or university is generally required for admission into the Ph.D. program. In special cases, for exceptionally strong students with a four-year Bachelor of Science Honours degree, or equivalent, in physics, astronomy or engineering physics and who show great promise in terms of academic accomplishments and potential for research, the department may recommend the direct entry Ph.D. as per College of Graduate and Postgraduate Studies (CGPS) regulations.

In cooperation with People Friendship University of Russia (PFUR) the department also offers the Dual M. Sc. degree in Applied Physics and Computations. The admission requirements for this program are described in the University of Saskatchewan – PFUR Collaboration Agreement (agreement subjected to renewal).

In cooperation with Tokyo University of Science (TUS), Tokyo, Japan the department also offers the Dual M. Sc. degree in Applied Physics and Computations. The admission requirements for this program are described in the University of Saskatchewan – TUS Collaboration Agreement (agreement subjected to renewal).

All students must maintain continuous registration in the PHYS 994/996 (M.Sc./Ph.D.) research course. All students must successfully complete the on-line course GSR 960.0 – Ethics and Integrity. The supervisor and/or the individual student’s Advisory Committee (AC) will recommend whether it is necessary for a student to take GSR 961 – Ethics in Human Research or GSR 962 – Ethics in Animal Research, and these courses, if necessary, will be included in the student’s Program of Studies. All graduate students must also be continuously enrolled in PHYS 990, the Seminar class.

Exceptional students in the M.Sc. program who show great promise, both in terms of academic accomplishment and potential for Ph.D. research, may be transferred to a Ph.D. program after the first year of studies but not later than two years after the initial enrollment in the M.Sc. program (see Section 3.2c for procedures).

2. Advisory Committee

2.1 General

As soon as possible, following a student's initial registration in his/her program, the student’s Advisory

Committee (AC) is formed. The members of the AC are named by the departmental Graduate Chair in consultation with the supervisor. The M.Sc. or Ph.D. AC must consist of at least two (Msc) or three (PhD) voting members:

- **Supervisor** (and **Co-Supervisor**, if applicable)
- **Additional Members** – one faculty member. The area of expertise of this member must be closely related to the student's area of research
- **Cognate Member** from another department at the USask; a minimum of one for a Ph.D. program, not required for an M.Sc. Program.

It is the responsibility of the Advisory Committee to provide support and advice, develop and recommend the Program of Studies, annually evaluate the student's progress through a formal meeting, and take appropriate and timely action in view of this progress. Progress in all aspects of the program is considered, including course work and research. Records of the evaluations and all actions taken must be maintained on file by the Graduate Secretary/Chair and the minutes from AC meetings are filed with annual progress reports.

2.2 Annual Progress Report Meeting

Progress report meetings of the graduate student Advisory Committee must occur annually. Progress meetings will be attended by the student, the Advisory Committee, as well as an Advisory Meeting Secretary, a faculty member appointed by the Graduate Chair or Head of the department. The Supervisor may not under any circumstances serve as secretary of the advisory meetings. The role of the secretary is to direct the advisory committee meeting and take the minutes.

At the annual Progress Report meeting, the student makes a brief oral presentation (maximum 15 min) reporting research project objectives and achieved progress in the respective year and in relation to the previous thesis work (if applicable) and responds to two rounds of questions from the Advisory Committee members.

At least one week before the meeting, the student submits the progress report (PHYS 994/996 report) summarizing the research work on the thesis completed up to the time of the meeting. The report in electronic form is forwarded to the Graduate Secretary, all members of the Advisory Committee and the Advisory Meeting Secretary.

- It is expected that in the first year, the report will outline the proposed thesis project, including the background relevant to the research undertaken, any work completed so far, and work planned for the future. The written report must be around 15 pages.
- In subsequent years, the report informs the AC of the progress since the last meeting, any changes in the research goals and presents results obtained since the previous meeting. The written report must be 2-5 pages. If major changes to the research project occurred since the last AC meeting, the report shall be written as if it is the first report.

All written reports must use 12 pt font (Times or Similar), 1 or 1.5 line spacing and 2.5cm margins. Additionally, for every Progress Report meeting, the student provides a summary of the course work completed (with grades obtained) and any formal research accomplishments, such as seminars, conference presentations, papers published, and papers submitted for publication.

3. Degree Requirements

Each graduate degree program entails a Program of Studies and additional requirements as described below. A Program of Studies details the specific courses appropriate to the student's research specialty and required for the degree. The Program of Studies is recommended by the student's AC. It is approved by the department's Graduate Chair within the first year of a student's program and filed with the CGPS. Passing grades as per CGPS regulations are required for all courses in the Program of Studies. Each graduate degree program has certain qualifying requirements that can be satisfied either as part of the course work or the thesis defence performed for a previous degree, or by the course work in the Program of Studies for the graduate degree as detailed below.

Each graduate degree program has certain qualifying requirements as detailed below.

3.1. M.Sc. Students

- **Electromagnetism and Quantum Mechanics Requirements:** All students completing an M.Sc. program offered by the Department of Physics and Engineering Physics must have background knowledge in electromagnetic theory or quantum mechanics. This requirement is met by the following classes offered in the department:
 - PHYS 456.3 Electricity and Magnetism II, and
 - PHYS 481.3 Quantum Mechanics II

Equivalent courses from other Universities may be taken as meeting this requirement. In consultation with the supervisor, the GAC chair will decide if a formal meeting of the AC is required to review the previously taken courses and/or examine the student's knowledge of the material. If, at that meeting, the AC is not satisfied, the AC can require that the student takes one or both of PHYS 816.3 and/or PHYS 883.3. This decision will require approval of the GAC Chair. The decision will be communicated to the student in writing on the form signed by the Chair of the AC and the GAC Chair. If the AC decides that the classes taken and grades obtained are equivalent to the USask requirements, a student can take any other graduate class, subject to the approval of the AC.

Students with a degree from USask without one or both courses and students from other universities without the equivalents of these courses in their earlier program will be required to take two out of four of the following courses:

- PHYS 816.3 Electrodynamics
- PHYS 883.3 Quantum Mechanics
- PHYS 873.3 Statistical Mechanics
- PHYS 828.3 Computational Physics Methods

with at least one of those to be PHYS 816.3 or PHYS 883.3, as part of their Program of Studies. If a student took PHYS 456.3 and/or PHYS 481.3 previously, they cannot take PHYS 816.3 and/or PHYS 883.3, respectively.

- **Program of Studies:** M.Sc. students must take a minimum of 12 cu of graduate course work.
- **Defence of Thesis:** See Section 7.

3.2. Ph.D. students:

a) With an M.Sc degree in Physics and Engineering Physics from the University of Saskatchewan

- **Electromagnetism and Quantum Mechanics Requirements:** Students must successfully complete a minimum of 9 cu of graduate course work beyond the courses completed as part of the M.Sc. Degree. All students completing a Ph.D. program offered by the Department of Physics and Engineering Physics must have background knowledge in electromagnetic theory and quantum mechanics. Ph.D. students who have not taken PHYS 816.3 (PHYS 456.3) or PHYS 883.3 (PHYS 481.3), must take the missing course.

Program of Studies: Students must complete a minimum of 9 cu of graduate courses including at least one of:

- PHYS 812.3 Electromagnetic Theory
- PHYS 873.3 Statistical Mechanics
- PHYS 886.3 Relativistic Quantum Mechanics

Ph.D. students cannot take PHYS 816.3 and PHYS 883.3 as part of the minimum 9 cu. Students who are required by the AC to take one of PHYS 816.3 and PHYS 883.3 as detailed above must complete a minimum of 12.

- **Qualifying Examination:** The Oral Examination (defence) for the award of the Master's degree is accepted in lieu of the Qualifying Examination.
- **Comprehensive Exam:** See Section 5.
- **Departmental Seminar:** See Section 6.
- **Defence of Thesis:** See Section 7.

b) With a graduate degree other than an M.Sc. in Physics and Engineering Physics from the University of Saskatchewan

- **Electromagnetism and Quantum Mechanics Requirements:** All students completing a Ph.D. program offered by the Department of Physics and Engineering Physics must have background knowledge in electromagnetic theory and quantum mechanics. Students should show their competency in electromagnetic theory and quantum mechanics at the level of
 - PHYS 816.3 Electrodynamics
 - PHYS 883.3 Quantum Mechanics

In the case that equivalent courses were taken as part of previous degrees, a formal AC meeting is required to examine if the student's knowledge of Electromagnetic Theory and Quantum Mechanics is satisfactory. The information about such courses (including the detailed outlines and textbook) must be provided by the student to the Graduate secretary before the meeting.

If the AC is not satisfied with the students' knowledge, the AC will recommend taking one or both of PHYS 816.3 and/or PHYS 883.3. This recommendation must be approved by GAC Chair.

The decision is communicated to the student in writing on the Program of Studies form signed by the Chair of the Advisory Committee and GAC Chair. The meeting should occur within the first months of registration in the program.

- **Program of Studies:** Students must complete a minimum of 9 cu of graduate courses including

at least one of:

- PHYS 812.3 Electromagnetic Theory
- PHYS 873.3 Statistical Mechanics
- PHYS 886.3 Relativistic Quantum Mechanics

Ph.D. students cannot take PHYS 816.3 and PHYS 883.3 as part of the minimum 9 cu. Students who are required by the AC to take one or both of PHYS 816.3 and PHYS 883.3 as detailed above must complete a minimum of 12 cu or 15 cu, respectively.

Qualifying Examination: The Oral Examination (defence) for the award of the Master's degree at the recognized universities may be accepted in lieu of the Qualifying Examination. The AC makes decision on whether full Qualifying Examination (as described in Section 4) is required at the meeting which should occur within the first months of registration in the program. Normally, it will be the same AC meeting where the Electromagnetism and Quantum Mechanics qualifying requirements will be determined. At this meeting, the student makes a presentation on his/her M.Sc. thesis and answers questions from the AC members. The questions should cover both the M.Sc. thesis subject and general physics subjects. If the AC is not satisfied with either component, the recommendation for a full Qualifying Examination should be made.

- **Comprehensive Exam:** See Section 4.
- **Departmental Seminar:** See Section 5.
- **Defence of Thesis:** See Section 6.3.

c) Requesting transfer from the M.Sc. Program to the Ph. D. program

- **Qualifying Requirements:** M.Sc. students who wish to transfer to the Ph.D. program must complete at least 9 credit units before the transfer, have high academic standing and have successfully completed a Qualifying Examination. The student must discuss the transfer with the supervisor. Recommendation for transfer is then made by the student's supervisor and is considered by the AC during Qualifying Examinations. The AC will make the recommendation for transfer based on the results of the student's course work and the qualifying examination. The AC recommendation must be approved by the Graduate Chair and is submitted to CGPS for final approval. The qualifying exam must occur in time to allow the student to register in the Ph.D. program not later than two years after initial enrolment in the M.Sc. program.
- **Program of Studies:** Overall, the student must complete a total of at least 21 cu of approved graduate level courses. All students completing a Ph.D. program offered by the Department of Physics and Engineering Physics must have background knowledge in electromagnetic theory and quantum mechanics. He/she should take
 - PHYS 816.3 Electrodynamics
 - PHYS 883.3 Quantum Mechanics

unless, at commencement of the M.Sc. program, the AC had waived the requirement to take PHYS 816.3 or PHYS 883.3 as detailed in Section 3.1. In this case, credit units are fulfilled by another graduate course as approved by the AC.

In addition to the above classes, a student should take **one of:**

- PHYS 812.3 Electromagnetic Theory

- PHYS 873.3 Statistical Mechanics
- PHYS 886.3 Relativistic Quantum Mechanics
- **Comprehensive Exam:** See Section 5.
- **Departmental Seminar:** See Section 6.
- **Defence of Thesis:** See Section 7.

d) Students in direct entry Ph.D. program, must complete a total of at least 21 cu of approved graduate level courses (as described in the Section 3.2 (c)). The students in **direct entry Ph.D. program** must complete the Qualifying Examination within two years from the beginning of the program, and after completing the required qualifying courses in Quantum mechanics and Electromagnetism (M.Sc. Level PHYS 883.3 and PHYS 816.3) and Ph.D. qualifying courses (one out of PHYS 812.3, PHYS 873.3, or PHYS 886.3).

4. Qualifying Examination

The qualifying exam is conducted by the student's AC committee. For M.Sc. students who wish to transfer to the Ph.D. program, a cognate member from another department has to be added to AC for the qualifying examination. The purpose of the examination is to ensure that

- the student has the potential to successfully acquire knowledge of Physics and Engineering Physics disciplines at the level appropriate for a Ph.D. degree,
- there is evidence the student has required research skills and knowledge to be able to successfully complete a Ph.D. dissertation, and
- there is evidence of good writing and oral communication ability.

Before the qualifying examination, students must present a written report to the AC. The written report should be 15-20 pages in length (1.5-line spacing) and must contain a review of the physics/engineering background appropriate to their research specialization, a survey of the literature appropriate to their research project, information specific to the research project, preliminary results and a plan for future Ph.D. project work. The report format should be consistent with the recommended thesis formats. This report must be available for the AC at least one week before the examination. At the examination, the student makes an oral presentation, which should not exceed 15 minutes. The student then must respond to questions from the AC. Determination of whether the student has successfully passed the qualifying examination is based on the evaluation of the three points listed above. The qualifying examination can be retaken as per **CGPS** regulations. The qualifying examination for students who wish to transfer from M.Sc. to Ph.D. degree cannot be retaken. If the AC committee is not satisfied, the student is recommended to complete the current M.Sc. program.

5. Comprehensive Exam

All students in a Ph.D. program must pass a comprehensive examination. The purpose of the Comprehensive Examination is to determine whether the student has a mature and substantive grasp of the Physics and Engineering Physics disciplines as a whole. The comprehensive examination is normally scheduled in the second or later years, after all course work requirements are completed. The

comprehensive examination consists of a written report, an oral presentation, and oral defence of the written report.

The written report is normally in the range of 15-20 pages (1.5-line spacing) in length and should follow the formatting of the well-established physics journals in the particular discipline. The report must contain a mini-review of an important topic from recent physics and engineering physics literature. The topic should not be a part of student's current research, but it could be within the student's general area of research. The mini-review should be based on 20-40 primary references.

The student must submit the report (one paper and one electronic copy) at least one week before the oral presentation. Paper copies of the report will be distributed to all AC members and electronic copy to all faculty and graduate students. Written comments on the report from the AC are welcome and should be submitted to the Graduate Secretary before the seminar presentation described below.

The student will present a formal seminar of 30 minutes in length on his/her review topic as part of the Graduate Physics and Engineering Physics Seminar series. All faculty and graduate students are invited to attend and ask questions. The members of the Advisory Committee must be present at the seminar and will submit written comments to the AC Chair on the Comprehensive Examination Report. A meeting of the AC after the seminar is required at which the further questioning of the student may occur. The outcome of the exam will be determined at this meeting. The student will be evaluated on a basis of the written report, ability to communicate and present ideas clearly in written and oral form, and ability to respond to the questions. Determination of whether the student has passed the Comprehensive Exam is based on the evaluation of all components above. The Advisory Committee may require the student to resubmit the written report (generally within 4 weeks of the presentation). If the committee finds significant deficiencies and believes that the student did not meet the standard expected of a Ph.D. candidate, the "fail" recommendation will be made. A failed examination may be repeated once, with the permission of the Dean of CGPS. Satisfactory completion of the Comprehensive Examination is required before the student may continue with his/her program, and failure will result in the student being "Required to Withdraw" from the Ph.D. Program.

6. Departmental Seminar

All Ph.D. candidates are required to give a one-hour seminar for the departmental seminar series (Phys 990 requirement). The presentation should focus on the physical processes involved in the research project and in general be accessible to general physics and engineering physics audience (in particular, to the 3-rd and 4-th year physics and engineering physics students).

7. Defence of Thesis

7.1 Examining Committee

The Examining Committee is typically formed from the members of the Advisory Committee with the addition of an external examiner, which is appointed by CGPS on the recommendation of the AC.

The external examiner for an M.Sc. thesis must be from outside the Physics and Engineering Physics department. The external examiner of a Ph.D. thesis must not be a current faculty member or employee of the USask. In addition, for a PhD thesis, a University examiner with suitable knowledge in the general field of dissertation research shall be appointed by CGPS on the recommendation of the AC.

The chair of the examining committee is the secretary of the advisory committee. The Supervisor may not under any circumstances serve as chair of the examining committee. General guidelines of **CGPS**

for selection of external examiner must be followed.

7.3. M.Sc. Thesis Defence

An M.Sc. candidate and the supervisor initially decide when the thesis is ready to be considered by the members of the AC, and the supervisor compiles a list of possible candidates as the extra-Departmental examiner. The decision on whether the thesis is ready for defence occurs at a formal meeting of the Advisory Committee, which also approves the External Examiner. The student shall attend the first part of this meeting. A copy of the thesis that is intended for submission to the Examining Committee for the Thesis Defence must be made available to the members of the Advisory Committee not later than one week before the meeting. The Advisory Committee approves the thesis for defence (or makes recommendations for revisions) and makes the selection of the external examiner, which has to be approved by GAC Chair. The CGPS is informed of the details of thesis defence (date, name and affiliation of the external examiner etc.). The thesis, revised if necessary, must then be available to the Examining Committee at least 3 weeks before the thesis defence. The Examining committee consist of the Advisory committee and the appointed external examiner. The chair of the examining committee is the secretary of the advisory committee.

The CGPS must be notified a minimum of three weeks prior to the desired oral defence date. Upon receipt of the notification, a convocation check will be completed by the CGPS to verify that all program requirements have been met, including current registration.

At an M.Sc. defence, the candidate begins with a 15-minute oral presentation, which is open to the public. The Chair of the Examining Committee may allow for questions to be asked by guests in the end of the oral presentation. The Examining Committee then reconvenes, and the candidate responds to oral questioning. The guests may be present during questioning unless requested otherwise by the candidate or AC. Such requests should be communicated to the AC Chair in advance of the defence. The guests may not participate in questioning of the candidate.

When the Examining Committee is satisfied that sufficient questioning has occurred to make a decision, the candidate and guests are excused and the committee decides if the thesis and its defence are satisfactory. Recommendations of the Examining Committee are based on the University of Saskatchewan Policies and Procedures for M.Sc. and Ph.D. defences. General guidelines for the Role of the Examining Committee and External Examiner for Oral Thesis Examination at the University of Saskatchewan should be followed.

7.4. Ph.D. Thesis Defence

The decision on whether the thesis is ready for defence occurs at a formal meeting of the Advisory Committee. The student shall attend the first part of this meeting to learn first-hand of any changes required to be made prior to the final approval of the thesis for the defence. A copy of the thesis that is intended for submission to the CGPS must be made available to the members of the Advisory Committee not later than one week before this meeting. After the Advisory Committee approves the thesis for defence (or makes recommendations for revisions) at the meeting, the necessary documentation is submitted to **CGPS**.

At the AC meeting, a prioritized list of three potential external examiners is also discussed and recommended to the CGPS (the Dean or designate makes the final choice). Brief CVs and publication

list of the potential external examiners are required for the meeting. General **CGPS** Policy on the conflict of interest is to be followed.

The defence is scheduled not earlier than 4 weeks after the thesis has been submitted to the **CGPS**.

The chair of the examining committee is the secretary of the advisory committee.

The **CGPS** must be sent the necessary documentation (including the dissertation) a minimum of six (6) weeks prior to the desired oral defence date. After approval by the **CGPS**, the External Examiner must have the thesis a minimum of four (4) weeks prior to the defence.

The candidate begins with a 20-minute oral presentation, which is open to the public. The Chair of the Examining Committee may allow for questions to be asked by guests in the end of the oral presentation. The Examining Committee then reconvenes and the candidate responds to oral questioning. The guests may be present during questioning unless requested otherwise by the candidate or AC. Such requests should be communicated to the Chair of AC in advance of the defence. The guests may not participate in questioning of the candidate.

When the Examining Committee is satisfied that sufficient questioning has occurred to make a decision, the candidate and any guests are excused and the **CGPS** representative again takes over the chairing duties. The Committee decides if the thesis and its defence are satisfactory. Recommendations of the Examining Committee are based on the University of Saskatchewan Policies and Procedures for Ph.D. defences. General guidelines for the Role of the Examining Committee and External Examiner for Oral Thesis Examination at the University of Saskatchewan will be followed.

The major distinction between the Departmental expectations for M.Sc. and Ph.D. theses is the originality of the research. It is generally expected that the research associated with a Ph.D. thesis will either have been published, or be judged publishable by the Examining Committee.

8. Thesis format and submission

Theses in the department typically follow standard thesis format guidelines. General College of Graduate Studies “Guideline for Preparation of a Thesis” should be followed in thesis preparation. The requirements specific to the Department of Physics and Engineering Physics are described in the accompanying document available from the Department of Physics and Engineering Physics website.

The **CGPS** and the department allow the submission of the thesis in a ‘manuscript style’ that consists of a series of published peer reviewed manuscripts from appropriate journals. The decision to use the manuscript style thesis must be approved by the Advisory Committee before the candidate begins writing the thesis.

As the thesis represents the dissemination of significant independent research results, for the manuscript style thesis, the department will only accept publications with the student as a leading author of the manuscript. The student must supply additional documentation to the Examining Committee that provides an explanation of the student’s role in each manuscript. This documentation must demonstrate that the student served a major and pivotal role in completion of the work and was responsible for the writing of a significant and identifiable portion of the manuscript. The chapters

that are based on the published manuscripts where the candidate is not a leading author should be written in the standard thesis format.

In addition to the manuscripts, all the following are required for the ‘manuscript style’ thesis:

1. An introduction summarizing and critiquing the research on the topic as a whole, a literature review, and the rationale for the current study;
2. A section between each manuscript indicating its relationship to the thesis research in its entirety;
3. A general discussion and summary, which links the separate manuscripts and relates the student’s research to the topic as a whole.

The final approved version of the thesis (after defence) must be submitted to both the CGPS (electronically) and to the Graduate Secretary. Please note that it is the student’s responsibility to prepare and assemble all materials for the thesis in accordance with University and CGPS regulations and to ensure that the thesis document is complete and in good order. The Electronic Thesis Dissertation is submitted to the website <http://library.usask.ca/etd/>.