University of Regina

Department of Physics
Regina, Saskatchewan
Canada S4S 0A2

Physics 498/499: Senior Research Handbook

Version 1.2: September 18, 2019

Participation in this program gives physics undergraduates some experience in scientific research, and an appreciation for how physics research is performed. This experience includes not only performing experiments, analysis, simulations, or detector prototyping, but also important scientific skills such as drafting technical reports, oral presentation of results, and responding quickly to questions. These changes to our B.Sc. program requirements follow from Recommendation #4 of the 2016 Physics Unit Review: "The Honours program should require a written thesis."

The following structure has followed a review of the requirements of some other Canadian physics departments, as well as the honours thesis required by the UofR Chemistry Department, and incorporates several of the most attractive features of programs elsewhere. Phys 498 is required for Applied Physics majors. Both Phys 498 and 499 are required for the Physics B.Sc. Honours degree, which are intended to be taken in consecutive semesters, typically fall and winter.

1) Applied Physics B.Sc. Students

Applied Physics students are required to register in PHYS 498 for the final semester of their program. In order to obtain a grade of Complete (C), the student is required to:

1. Regularly attend the Physics Seminars, as scheduled, and if possible, notify the 498/9 coordinator in advance, if unable to attend a specific seminar.

2. At the beginning of the semester, Applied Physics students meet with the 498/9 coordinator right away, and choose a presentation topic and supervisor (usually a department faculty member) the first week of term.

a) It is anticipated the chosen topic will be on some application of physics to a practical or industrial problem. Unlike B.Sc. Honours students, there is no expectation of original research and no restriction on whether the work has been part of prior employment. However, if the presentation topic is based on work performed for an employer, it must be of significantly greater depth than already presented in a Co-Op workterm report.

b) Possible supervisors can be any faculty member in the Department of Physics, including the faculty member who graded the corresponding Co-Op workterm report (if applicable), the Co-Op coordinator, or possibly even the former employer (only with the approval of the 498/9 coordinator).

3. By the end of the first month, submit to the 498/9 coordinator a typed document (minimum one page) including:

- student name and number
- proposed title of the presentation
- several paragraph description of the topic
- supervisor name

4. 2-3 hours of work per week, including literature review, presentation work, regular meeting with supervisor to discuss progress, etc.

5. Oral Presentation (20 minutes), before a 3-person committee of friendly professors, anytime from 4 days before end of classes to 1 week into exam period (consult with the 498/9 coordinator).

6. Fielding questions (10 minutes) from the committee immediately after the presentation, related to your presentation and designed for assessment of your comprehension.

PHYS 498: Grading Scheme

Although only a grade of C will appear on the student transcript, it is often useful for the student to receive feedback on their performance. A suggested grading scheme is below:

498 Presentation	45%
498 Fielding questions	55%

2) Physics B.Sc. Honours Students

Fall of 4th Year – PHYS 498 (0 credit)

In the "498" semester, students meet with the 498/9 coordinator right away, and choose a research project and supervisor (usually a department faculty member) the first week of term. Students are free to consult with as many potential supervisors as they wish before making their decision. Some students negotiate a project with a professor in advance of the Fall semester, but they cannot include summer or other employed work as part of their honours project.

Once a supervisor is chosen and the 498/9 coordinator is informed, PHYS 498 consists of the following:

1. Regularly attend the Physics Seminars, as scheduled, and if possible, notify the 498/9 coordinator in advance, if unable to attend a specific seminar.

2. 2-3 hours of work per week, including literature review, planning scope of laboratory research, working on written progress report and oral presentation, regular meeting with supervisor to discuss progress, etc.

3. Written Progress Report (5-10 pages). A 1st draft is due for your supervisor 11 weeks into semester (for their advice), and 3 final copies (for the committee) are handed in to the 498/9 coordinator 12 weeks into semester. (e.g. if the 1st day of classes is a Wednesday, the due dates are Wednesdays.)

4. Oral Presentation (10 minutes) of the Report, before a 3-person committee of friendly professors, usually the day before the semester exam period.

5. Fielding questions (10 minutes) from the committee immediately after the Presentation, related to your research and designed for assessment of your comprehension.

Winter of 4th Year – PHYS 499 (3 credit)

In the "499" semester, research work continues in earnest, leading to a written Thesis and oral Defense of the work. PHYS 499 consists of the following:

1. Regularly attend the Physics Seminars, as scheduled, and if possible, notify the 498/9 coordinator in advance, if unable to attend a specific seminar.

2. 6-10 hours of work per week, including laboratory research, research thesis and oral presentation preparation, regular meeting with supervisor, etc.

3. Written Research Thesis (25-40 pages). A 1st draft is due for your supervisor 11 weeks into semester (for their advice), and 3 final copies (for the committee) are handed in to the 498/9 coordinator 12 weeks into semester. (e.g. if the 1st day of classes is a Wednesday, the due dates are Wednesdays.)

4. Oral Presentation (15 minutes) of the Thesis, before a 3-person committee of friendly professors, anytime from 4 days before end of classes to 1 week into exam period (consult with the 498/9 coordinator).

5. Fielding questions ("Thesis Defense", 20 minutes) from the committee immediately after the Presentation, related to your research and designed for assessment of your comprehension.

6. Corrected Research Thesis. 3 unbound copies, with committee-requested corrections made, are handed to the 498/9 coordinator, which the Department will convert into bound copies for

posterity (for the student, the supervisor, and the Department). This is due 5 days after the Defense.

7. Release Form. The student must clean up their lab equipment/computer files and after making the final changes to the thesis recommended to the committee, submit the final copy to the Physics Department Library for archival purposes. The signed form is also due 5 days after the Defense.

PHYS 498/9: Grading Scheme

Student progress is expected to be somewhat limited in the 498 semester relative to the 499 semester, due to a training period for students new to research and the reduced time expectations. For that reason, the 498 progress report (written and oral) is down-weighted relative to the 499 thesis (written and oral). The following is only slightly modified from the CHEM 401/402 grading scheme.

End of 498: tell the student their grade for the 498 components, but temporarily enter IP (In Progress) for the 498 grade.

End of 499: derive an overall grade for the sum of the 498/9 work, and enter this grade for both 498 and 499.

498 Research Performance, assessment by supervisor	0.0250 (0.10 x 25%)
498 Report, written	0.1125 (0.45 x 25%)
498 Report, oral presentation	0.0500 (0.20 x 25%)
498 Report, fielding questions	0.0625 (0.25 x 25%)
499 Research Performance, assessment by supervisor	0.2250 (0.30 x 75%)
499 Thesis, written	0.2250 (0.30 x 75%)
499 Thesis, oral presentation	0.1125 (0.15 x 75%)
499 Thesis, fielding questions ("defense")	0.1875 (0.25 x 75%)

The “research performance” category will reflect your research effort, talent, and accomplishments. (Don't get discouraged if your studies do not work out as planned, your research attitude and level of skills gained are at least as important.)

PHYS 498/499 Report Writing

There are two reports to write:

- Phys 498 Progress Report (5-10 pages)
- Phys 499 Research Thesis (25-40 pages)

The two reports will also serve to spread out the workload of writing a thesis, since much of the progress report (e.g. Introduction (largely a literature review) and Methods sections, plus some tables/figures) can be copied into the thesis.

Style tips: LaTeX is preferred, following the format of a well-recognized journal, such as the APS (revtex-4) style-files. All reports must be typed using a readable font size (e.g. 12-point Times New Roman), 1.5-spaced. Headings and section titles should be bold and/or underlined, and numbered. References should follow a professional journal format. Avoid quoting web pages, or plagiarizing figures from the internet. Diagrams, tables, and graphs are generally very useful in explaining results, and should be numbered consecutively (Table 1, Figure 1, ...) with descriptive captions so the reader can understand what information they are designed to present. The first page of the Introduction should be Page 1; all earlier pages should be labeled with roman numerals (i, ii, iii, ...). Consult an old thesis for more style syntax.

Suggestions:

- Start organizing your thoughts by preparing an outline that contains headings and ideas. Go back and fill in the details.
- The number of pages is limited so be careful about the amount you write. Know your audience -- assume your readers have some knowledge in the field but are not as expert as you. Write down only those details that would allow them to understand what you have done and to repeat the work if that were necessary.
- You may find it easier to finalize all the data into tables, graphs, and figures, before writing the text for the Results and Discussion section.
- Use figures, tables, and graphs where they are most useful for illustration and explanation.
- Subheadings may be helpful, especially in the Results and Discussion section(s) (but don't go crazy with this).
- Detailed calculations, or large numbers of graphs and tables, should be placed in Appendices. In that case, use only a few illustrative examples in the body of the report.
- Write clearly, in well-constructed, complete and grammatically correct sentences. Past-tense passive is preferred ("The detector was calibrated", rather than "I/We calibrated the detector"). Proofread carefully. One common problem is lack of agreement between subject and verb (The table suggests, or the values suggest), Another common mistake is the improper usage of data/datum. Data is plural and must have the appropriate plural article and verb. Datum is singular.

PHYS 498/499 Report Writing (continued)

498: the Progress Report

Research companies love to see Progress Reports from their staff scientists to keep an eye on research progress. In 498, it will serve to:

1. Give you practice and feedback in scientific writing (useful in advance of the 499 Thesis);

2. Distribute the workload of writing a Thesis;

3. Allow the 498 committee to assess your scientific writing skills.

499: the Research Thesis

A Thesis represents new knowledge generated from academic research. The document has more in common with a scientific report than a published science journal article, although both styles are quite similar. (For instance, a thesis may have more details and a more general introduction than a journal article.) In 499, the Research Thesis serves to:

1. Gives you practice writing a full scientific report, including collecting data and forming conclusions;

2. Allow your supervisor to assess your results

3. Allow the 499 committee to assess your scientific writing skills.

The following table summarizes the sections expected in each report.

Section	498 Progress Report	499 Research Thesis
Title Page	yes	yes
Abstract, a summary paragraph		yes
Acknowledgments		yes
Table of Contents	yes	yes
List of Tables		yes
List of Figures		yes
List of Abbreviations		yes
Introduction	yes	yes
Methodology [1]	yes	yes
Results and Discussion	yes	yes
Conclusions [2]		yes
Future Work [3]	yes	
References	yes	yes
Appendix	optional	optional

1 e.g. equipment or algorithm used, calibrations, data analysis, corrections applied...
2 State what you believe the results tell you about your problem/hypothesis, with a brief summary of the data and how it led you to these conclusions.
3 Describes what research will be done in 499 (if applicable).

Physics Library Release Form
University of Regina
Undergraduate Honours Dissertation
Physics 498/499

(Signed release forms must accompany an Undergraduate Honours Dissertation when it is submitted to the Physics Department.)

STUDENT NAME: _____ STUDENT NUMBER: _____

DEGREE PROGRAM: _____ MAJOR: _____

TITLE OF ESSAY/DISSERTATION: _____

In accordance with the regulations for the Honours degree of Bachelor of Science, a copy of the essay/dissertation which was required of me is herewith submitted to the Department of Physics Library.

I recognize that the copyright on the essay/dissertation belongs to me, and that the Regulations require that the essay/dissertation shall be available for unrestricted consultation by students and faculty, except under very exceptional circumstances which must be approved by the Department of Physics.

Please check either A or B below:

_____ A. I do not wish to request restrictions on the time at which the essay/dissertation shall first be made available.

_____ B. I do wish to request a restriction so that the essay/dissertation will be withheld from public use for a period of ___ months from the date of submission. My supporting reason for this request is:

___ (a) It is my intention to have my work published.

___ (b) An academic extension of the work will be made in a short time.

___ (c) Patent possibilities exist which I wish to protect.

___ (d) Other: _____ Please specify:

_____

_____

I hereby request the Department of Physics to consider this application for restriction and to inform me of its decision in due course.

I understand that the Department of Physics is entitled to receive applications for the restriction of availability of my essay/dissertation from third persons and to adjudicate on such applications

_____ _____
Signature of Student Signature of Head of Department

_____ _____
Signature of Witness Date