

PHYS*4500 – ADVANCED PHYSICS LABORATORY
FALL 2017 COURSE OUTLINE
DEPARTMENT OF PHYSICS, UNIVERSITY OF GUELPH

Section 1: Instructional Support

Section 1.1: Course Instructor

| Course Instructor | Office Location | Email |
|---------------------------|------------------------|----------------------|
| Christian Schultz-Nielsen | MacNaughton 431 | cschultz@uoguelph.ca |

Section 1.2: Graduate Teaching Assistant

| Teaching Assistant | Office Location | Email |
|---------------------------|------------------------|---------------------|
| Andrew Harris | MacNaughton 406 | harrisa@uoguelph.ca |

Section 1.3: Laboratory Technicians

| Laboratory Technicians | Office Location | Email |
|-------------------------------|------------------------|----------------------|
| Dave Urbshas | MacNaughton 104 | durbshas@uoguelph.ca |

Section 2: Learning Resources

Section 2.1: Course Website

Course material, news, announcements, and grades will be regularly posted to the PHYS*3510/4500 CourseLink site. You are responsible for checking the site regularly. Please ensure that your grades are recorded correctly and notify the course instructor of any discrepancies.

Section 2.2: Primary Course Reference

None.

Section 2.3: Recommended Course References

A.C. Melissinos and J. Napolitano, *Experiments in Modern Physics* (2nd Edition), Academic Press, 2003. (University of Guelph Library Call #: QC33.M52 2003)

J.R. Taylor, *An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements* (2nd Edition), University Science Books, 1997. (University of Guelph Library Call #: QC39.T4 1997)

D.W. Preston and E.R. Dietz, *The Art of Experimental Physics*, Wiley & Sons, 1991. (University of Guelph Library Call #: QC33.P74 1991)

Students will typically make extensive use of various textbooks from current and previous physics courses. Refer to specific lab outlines for more detailed references.

Section 2.4: Communication and Email Policy

Laboratory sessions are your primary opportunity to ask questions about the course.

The course instructor is available to provide help in his office during designated office hours (Mondays and Wednesdays, 1:30 – 2:20 PM). If you wish to obtain help from the course instructor at another time, please email to make an appointment or see them before or after labs to arrange a mutually convenient time.

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: email is the official route of communication between the University of Guelph and its students.

Section 3: Assessment

Section 3.1: Final Grade Breakdown

| Assessment Tool | Weighting |
|--|------------------|
| Lab Notebook (equal weighting for each of the 5 experiments) | 25% |
| Formal Lab – Science Paper (2 reports, equally weighted) | 25% |
| Formal Lab – Extended Abstract (2 reports, equally weighted) | 10% |
| Formal Lab – Poster First Draft | 2.5% |
| Formal Lab – Poster Presentation | 7.5% |
| Formal Lab – Poster Peer Evaluation | 2.5% |
| Group Project – Essay | 10% |
| Group Project – Oral Presentation | 10% |
| Group Project – Peer Evaluation | 2.5% |
| Lab Skills & Performance | 5% |

Section 3.1.1: Lab Notebooks

Students will submit their lab notebooks on the Wednesday (by 4:30 pm) following each experiment week for your group. Notebooks will be evaluated based on the criteria described below, and will be available for pick-up on the following Monday during scheduled lab time. Students are encouraged to keep two separate lab books to allow the GTA sufficient time to grade the lab books. Students may continue to use their lab notebooks from PHYS*3510 or PHYS*2180.

Students should be writing in their lab notebooks as they perform the experiment. Students will be assessed using the following criteria:

1. Materials & Methods (5)
 - briefly describe what was done as it is done – you should be able to reproduce the procedure from the notebook without the lab outline!
 - logging experimental conditions
 - data recording
 - dates, run times, file names, etc.
2. Results & Analysis (3)
 - raw data (where applicable) and quality of that data
 - graphs and brief discussions of the data
 - questions asked in the lab outline do not need to be addressed in your lab notebook
 - derivations of equations do not need to be included in your lab notebook
3. Clarity (2)
 - notebook should be legible and reasonable and easily navigable

Please note that your lab notebook does not require a detailed motivation/introduction section for each experiment. This information will be provided in your scientific paper, extended abstract, or poster. If you are completing your notebook properly, you should only need to generate graphs, perform some calculations, and provide a very brief discussion of the data.

Section 3.1.2: Formal Lab – Science Paper

Each student will hand in two written formal lab reports, written in the style of a scientific paper. Formal lab reports are due in the Courselink Dropbox by midnight on the due dates given in the course timetable (see Section 5.1). Evaluation of the science papers will be based on students' ability to properly motivate the experiment that was performed, to interpret and discuss their experimental data while using proper scientific writing styles, and to properly discuss experimental limitations within accepted error analysis frameworks. Spelling and grammar will be assessed in these reports. In general, your science papers should not exceed 4-6 pages (1.5 line spacing) for most experiments. **You cannot submit science papers for experiments that have been submitted as extended abstracts or posters.**

Section 3.1.3: Formal Lab – Extended Abstract

Each student will hand in two written formal lab reports, written in the style of a scientific extended abstract. Formal lab reports are due in the Courselink Dropbox by midnight on the due dates given in the course timetable (see Section 5.1). Extended abstracts should not exceed 2 pages (1.5 line spacing) for most experiments, and should emphasize visual representation of your data. Motivation of the experiment is required, but this can be more succinct than the more comprehensive introduction found in a regular science paper. Brief derivations can be included in an appendix if the lab outline requires them to be completed. Questions asked in the lab outline should be addressed in your extended abstract, and calculated experimental values should include proper uncertainties. Your extended abstract

should focus on interpreting the experimental results and describing experimental limitations. **You cannot submit extended abstracts for experiments that have been submitted as science papers or posters.**

Section 3.1.4: Formal Lab – Poster (First Draft)

Each student will produce a scientific poster (48" wide by 36" high) summarizing the results of one of their experiments. This poster will be submitted electronically as a PDF document via Dropbox and assessed by the Graduate Teaching Assistant, who will provide useful feedback before the final poster presentations in Week 11. Students are encouraged to browse the scientific posters found throughout the MacNaughton building for guidance. A good principle while designing your poster is to maintain a balance of roughly 30% text, 30% visuals, and 30% empty space. **You cannot submit a poster for experiments that have been submitted as extended abstracts or science papers.**

Section 3.1.5: Formal Lab – Poster (Presentation)

After feedback has been received, students will print their posters (we will attempt to arrange a discount with one of the poster printers on campus, but there will be some cost for students) and present them to their peers in a PHYS*3510/4500 Poster Session scheduled on **Monday, November 27 from 2:30 – 5:20 PM in MacNaughton 415.**

Students will be divided into two groups, presenters and evaluators. For the first 90 minutes, the presenters will present their poster in 5 minutes or less (with up to 2 minutes of questions afterwards) to their peer evaluators (as well as the course instructor and teaching assistant), and will be assessed using a provided rubric. After 90 minutes, the student presenter group and evaluator group will switch roles. Students serving as evaluators should form groups of 2-3 students and visit each poster together to speed up the grading process.

Section 3.1.6: Formal Lab – Poster (Peer Evaluation)

Each student will use a provided rubric to grade their peers' poster presentations. Constructive feedback must be provided, which will be assembled and forwarded to the presenters anonymously. You will be evaluated on the quality of the feedback that you provide your peers.

Section 3.1.7: Group Project – Essay

During the first 5 weeks of the semester, students will work in groups of two, randomly assigned by the course instructor. Each group will submit a collaborative essay describing an experimental effort at the forefront of physics, with great examples including Nobel Prize winning research. This essay will provide an overview of the relevant physics and describe at least one relevant research paper.

Suitable topics include:

- gravitational wave observatories (likely Nobel Prize in the near future)
- neutrino observatories (Nobel Prize – 2002 and 2015)
- invention of blue light-emitting diodes (Nobel Prize – 2014)
- CERN Large Hadron Collider and the Higgs boson (Nobel Prize – 2013)
- quantum particle tracking/quantum computing (Nobel Prize – 2012)
- discovery of accelerating expansion of the universe (Nobel Prize – 2011)
- experiments with the two-dimensional material graphene (can also include more recent experiments with silicene) (Nobel Prize – 2010)
- transmission of light in optical fibers (Nobel Prize – 2009)
- invention of the CCD sensor (Nobel Prize – 2009)
- giant magnetoresistance (Nobel Prize – 2007)
- discovery of the blackbody form and anisotropy of the cosmic microwave background radiation (Nobel Prize – 2006)
- laser-based precision spectroscopy (Nobel Prize – 2005)
- achievement of Bose-Einstein condensation (Nobel Prize – 2001)
- laser cooling and trapping of atoms (Nobel Prize – 1996)

Students who wish to discuss a different project or experiment can do so if they receive permission from the instructor. Student topics must be unique to avoid overlap with other groups in the class. Students enrolled in PHYS*4001/2 are prohibited from choosing topics associated with their senior projects to avoid getting double credit for the same academic work, and students should avoid choosing essay topics that are closely related to previous summer research projects. **Essays will be submitted via Dropbox as Microsoft Word documents (ideally) or PDF documents (for students who use LaTeX) by midnight on Friday, October 13th (Group A students) or Friday, October 20th (Group B students).**

Section 3.1.8: Group Project – Oral Presentation

Each group will present their chosen topic to their peers. The presentations will be no longer than 20 minutes, with 5 minutes for questions. **Oral presentations will be held from 2:30 – 5:20 pm on Wednesday, October 11 (Group A students) and Wednesday, October 18 (Group B students) in MacNaughton 222.**

Section 3.1.9: Group Project – Peer Evaluation

Each student will use a provided rubric to grade the oral presentations of their peers. Constructive feedback must be provided, which will be assembled and forwarded to the presenters anonymously. You will be evaluated on the quality of the feedback that you provide your peers.

Section 3.1.10: Lab Skills & Performance

Throughout the semester, the instructor and teaching assistant will be monitoring student attitudes and initiative in the laboratory. Students will be assessed on their willingness to try to understand experiments on their own (within reason – we do not want students wasting

their time when they have no idea what to do next and we certainly do not want equipment to be damaged), their preparedness for labs throughout the semester, and their ability to adhere to established lab safety protocols (e.g. no food or drink of any type in the lab room!). **Students are required to attend the lab during the assigned lab periods (2:30 – 5:20 pm on Mondays and Wednesdays), and attendance will be factored into this grade.**

Section 3.2: Time Conflicts Between Courses

Sometimes students will have a time conflict between a midterm exam in another course and either a lecture or a lab in this course. The University has a very clear policy to cover this situation: the regularly-scheduled lecture or lab holds priority. In other words, it is the responsibility of the faculty member who has scheduled the midterm exam to make special arrangements with students who have conflicts. [This policy](#) is stated explicitly in the 2017-2018 Undergraduate Calendar.

Section 3.3: Course Grading Policies

Section 3.3.1: Late Policy

All course deadlines are posted in this lab outline. We will not be moving these deadlines to accommodate the assignment or midterm deadlines of other courses. Students should budget their efforts accordingly, and are encouraged to complete their work long before the deadlines whenever possible. Late work will be penalized at 10% per day, and will no longer be accepted one week after the due date.

Section 3.3.2: Missed Assessments

If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor or TA. See the undergraduate calendar for information on [Regulations and Procedures for Academic Consideration](#).

Section 3.3.3: Accommodation of Religious Obligations

If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for [Academic Accommodation of Religious Obligations](#).

Section 3.3.4: Mark Adjustments

If you have questions about any grade, please inquire promptly after the material has been returned to you. Students are ultimately responsible for ensuring that the grades on all submitted material were entered properly in Courselink – check the entered grades frequently throughout the semester and report any discrepancies to your teaching assistant or course instructor.

Section 3.3.5: Passing Grade

To receive credit for PHYS*4500, the student must obtain a final grade of 50% or higher. For students that do not obtain a passing grade in the course, their final transcript will show the grade that they actually achieved in the course.

Section 4: Aims and Course Objectives

Section 4.1: Calendar Description

This is a modular course for students in any physics-related major in which techniques of nuclear, solid state and molecular physics will be studied.

Section 4.2: Course Aims

This course allows students to perform some basic but important experiments that illustrate topics discussed in third and fourth year physics courses. The students will obtain experience using modern laboratory instruments and practice methods of data acquisition and analysis. The student's scientific communication skills and ability to search the scientific literature will be developed.

Section 4.3: Learning Objectives

At the successful completion of this course, the student will:

- master the use of various experimental physics tools, including multimeters, oscilloscopes and multichannel analyzers.
- be autonomous in an experimental physics setting.
- master the analysis of experimental data, using accepted error analysis methodologies, to verify theoretical predictions.
- master proper scientific lab notebook protocols.
- demonstrate mastery with laboratory and radiation safety protocols, including proper handling of sealed gamma-ray emitting sources.
- master the written and verbal skills required to disseminate experimental results to a variety of audiences via scientific papers, posters, and oral presentations.
- identify and synthesize relevant scientific literature to present a coherent scientific argument.
- master the ability to use prior theoretical knowledge to draw appropriate inferences and conclusions from experimental results.
- master the ability to critically assess the uncertainties in experiments and propose appropriate improvements to the experimental procedures and analyses.

Section 4.4: Instructor's Role and Responsibility to Students

The instructor's role is to aid students in their performance of various experiments and provide guidance as students develop their mastery of the underlying physical concepts associated with these experiments.

Every student has the right to participate and contribute in the laboratory and other course activities. If a student feels that there is something preventing their full contribution, they must notify the course instructor or teaching assistants as soon as possible. We cannot fix problems that we are not aware of!

The instructor will ensure that the learning environment is free from harassment of any form. Offensive or inappropriate (homophobic, racist, sexist, etc.) comments are strictly prohibited. Offending students will be required to leave the lab or class, and a mark of zero will be given for any assessments arising from that course activity. More serious cases will also be forwarded to the University of Guelph Judicial Committee, where the maximum penalty is suspension or expulsion from the University of Guelph. For more details, students should consult the [University of Guelph's current Policy on Non-Academic Misconduct](#).

Section 4.5: Students' Learning Responsibility

Students are expected to take advantage of the assigned laboratory hours, as these are the only hours where students are guaranteed access to the course instructor and teaching assistant. All students are expected to attend the assigned classes and the lab performance grade will be based on assessments of student performance during these time periods.

Students who do (or may) fall behind due to illness, work, or extra-curricular activities (including varsity sports, student leadership activities, etc.) are advised to keep the instructor informed such that extra resources or accommodation can be provided, if appropriate.

Students are expected to complete their lab notebooks, formal lab reports and term projects in a timely fashion. Students are provided with deadlines for course materials at the beginning of the semester and are expected to work towards those deadlines accordingly. Extensions will not be granted except in exceptional medical or compassionate circumstances. Students should not wait until the deadlines to complete their coursework, as other course deadlines will start to interfere with the posted deadlines in PHYS*4500.

Section 4.6: Relationship With Other Courses & Labs

Section 4.6.1: Prerequisite Courses

Students must have completed PHYS*3510. Some labs will draw upon physics concepts previously discussed in previous courses, most notably PHYS*2180. Science communication skills developed in PHYS*2180 and PHYS*3510 will be reinforced.

Section 4.6.2: Restrictions

None.

Section 4.6.3: Follow-on Courses

Experiments in PHYS*4500 complement lecture material in other fourth year courses, most notably PHYS*4120, PHYS*4130, PHYS*4150, PHYS*3170, PHYS*4130, PHYS*4150, PHYS*4170, and PHYS*4070. As such, course notes and textbooks for these courses are

excellent resources for many of the experiments conducted in PHYS*4500. Lab notebook and scientific presentation (both verbal and written) skills will complement those developed in PHYS*4001/4002.

Section 5: Teaching and Learning Activities

Section 5.1: Timetable

| Week | Dates | Course Activities | Assessments Due |
|-------------|-----------------|--|--|
| 1 | Sep 11 – Sep 15 | <ul style="list-style-type: none"> • Lab Safety Training (Mon, Sep 11) • Radiation Safety Training (Wed, Sep 13) | |
| 2 | Sep 18 – Sep 22 | <ul style="list-style-type: none"> • Group A Experiment #1 | |
| 3 | Sep 25 – Sep 29 | <ul style="list-style-type: none"> • Group B Experiment #1 | <ul style="list-style-type: none"> • Group A Lab Notebook #1 |
| 4 | Oct 2 – Oct 6 | <ul style="list-style-type: none"> • Group A Experiment #2 | <ul style="list-style-type: none"> • Group B Lab Notebook #1 |
| 5 | Oct 9 – Oct 13 | <ul style="list-style-type: none"> • Group B Experiment #2 • Group A Oral Presentations and Peer Assessment | <ul style="list-style-type: none"> • Group A Lab Notebook #2 • Group A Essays • Group A Oral Presentations |
| 6 | Oct 16 – Oct 20 | <ul style="list-style-type: none"> • Group A Experiment #3 • Group B Oral Presentations and Peer Assessment | <ul style="list-style-type: none"> • Group B Lab Notebook #2 • Group B Essays • Group B Oral Presentations |
| 7 | Oct 23 – Oct 27 | <ul style="list-style-type: none"> • Group B Experiment #3 | <ul style="list-style-type: none"> • Group A Lab Notebook #3 • Group A Formal Paper #1 • Group A Extended Abstract #1 |
| 8 | Oct 30 – Nov 3 | <ul style="list-style-type: none"> • Group A Experiment #4 | <ul style="list-style-type: none"> • Group B Lab Notebook #3 • Group B Formal Paper #1 • Group B Extended Abstract #1 |
| 9 | Nov 6 – Nov 10 | <ul style="list-style-type: none"> • Group B Experiment #4 | <ul style="list-style-type: none"> • Group A Lab Notebook #4 • Group A Formal Poster Draft |
| 10 | Nov 13 – Nov 17 | <ul style="list-style-type: none"> • Group A Experiment #5 | <ul style="list-style-type: none"> • Group B Lab Notebook #4 • Group B Formal Poster Draft |
| 11 | Nov 20 – Nov 24 | <ul style="list-style-type: none"> • Group B Experiment #5 | <ul style="list-style-type: none"> • Group A Lab Notebook #5 • Group A Formal Paper #2 • Group A Extended Abstract #2 |
| 12 | Nov 27 – Dec 1 | <ul style="list-style-type: none"> • Poster Presentations and Peer Assessment | <ul style="list-style-type: none"> • Group B Lab Notebook #5 • Group B Formal Paper #2 • Group A Extended Abstract #2 |

Section 5.2: Experiment Scheduling

Students will be asked to split into two equal groups, Group A and Group B. Those in Group A will begin experiments in Week 2 and will have one week to complete the data collection for that experiment. Students in Group B will then have access to the equipment in Week 3, for one week. The two groups will alternate in this fashion throughout the semester with Group A doing experiments during the even weeks and Group B doing experiments during the odd weeks. All experiments should be completed by Week 11.

Students are required to complete the experiments during the assigned lab periods. Students requiring additional time to complete an experiment may sign out keys to MacNaughton 417 from the course instructor (see Section 6.3).

Each student will be required to do 5 of the labs listed below:

Modern Physics

1. Electron Spin Resonance
2. Zeeman Effect
3. Millikan Oil Drop Experiment
4. X-Ray Fluorescence: Moseley's Law

Nuclear Physics

1. Gamma-Ray Spectroscopy Using a NaI(Tl) Detector
2. High-Resolution Gamma-Ray Spectroscopy
3. The Speed of Photons: Galileo's Technique Modernized

Solid State Physics

1. X-Ray Diffraction (ask for permission – currently under repair)
2. The Hall Effect and Semiconductor Band Gap

Thermodynamics and Statistical Physics

1. Noise Fundamentals

Waves and Optics

1. The Velocity of Sound: The Debye-Sears Experiment
2. The Transmission Line
3. Fourier Optics
4. Physics of Ultrasound

Section 5.3: Signing Up for Experiments

Students can sign up for experiments using the Google Sheets link provided on Courselink. Please do not sign up for experiments outside of your assigned weeks unless all the groups for that week have already signed up for an experiment. Do not sign up for the same experiment as another group in the same week! Experiments are assigned on a first-come, first-served basis.

Section 5.4: Other Important Dates

Thursday November 2nd is the fortieth class day, the last day to drop one semester courses.

Section 6: Lab Safety

Section 6.1: Department of Physics Laboratory Safety Policy

The Department of Physics is committed to ensuring a safe working and learning environment for all students, staff and faculty. As a student in a laboratory course, you are responsible for

taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, students are responsible for reporting all safety issues to the graduate teaching assistant or course instructor as soon as possible. Students are not required to work in an environment that they deem to be unsafe. If you have any concerns whatsoever, please consult your teaching assistant or course instructors!

In this course, students may be exposed to the following potential hazards:

- γ -radiation and x-ray sources
- intense light, including laser light and strobe lights
- voltages and currents that can be harmful if proper precautions are not taken
- compressed gases
- cryogenic liquids: liquid nitrogen and liquid helium

All experiments have been designed to such that students have minimal (but not zero!) risk if proper laboratory protocols are followed. At all times, students must be aware of the risks of their experiment and the positioning of their fellow students and behave accordingly.

Section 6.2: Food and Drink in the Laboratory

As with all laboratories on the University of Guelph campus, **ALL food and drink is strictly prohibited** in the laboratory. This applies to all faculty, staff, and students. In the PHYS*4500 laboratory, this rule is strictly enforced as a criterion for lab certification with the Radiation Safety Office at the University of Guelph. Students must not, under any circumstances, bring any food or drink into the laboratory. If students have water bottles or food in their backpacks, these must be left at the front of the room and not be accessed within the room at any time.

Section 6.3: After-Hours Access to the Laboratory

Students who wish to work on their experiment outside normal course hours may sign out a key to MacNaughton 417 from the course instructor, on a case-by-case basis. Students must ensure that they are never in the laboratory alone, and must obey all safety rules. Should a course instructor, teaching assistant or lab supervisor come across students with food or drink in the laboratory, the offenders will be removed from the lab and receive a mark of 0 on that experiment.

Section 7: Academic Misconduct and Collaboration

Section 7.1: Collaboration

Collaboration and communication are essential for progress and advancement; much of modern society is built upon these skills. Students are encouraged to collaborate and discuss course concepts! However, all material submitted for grading must be each student's own work. Plagiarism is a form of academic misconduct, and will not be tolerated.

A good guideline when it comes to crossing the line from collaboration to academic misconduct (see next section) is that a student must never look at another student's written work. For the vast majority of students, they will be incapable at arriving at their own form of a derivation or analysis after they have looked at another student's work. For students seeking help from their peers, ask conceptual questions as opposed to, "How do you derive Equation 4?" For student helping their peers, never give the answer explicitly, but explain your reasoning.

Section 7.2: Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor. [The Academic Misconduct Policy](#) is detailed in the Undergraduate Calendar at the following link.

Section 8: Accessibility

Section 8.1: Accessibility

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Student Accessibility Services as soon as possible.

For more information, contact SAS at 519-824-4120 ext. 52073 or email sasnotes@uoguelph.ca or see the website: <https://wellness.uoguelph.ca/accessibility/>.

Section 8.2: Electronic Recording of Classes

The electronic recording of classes is expressly forbidden without the prior consent of the instructor. This prohibition extends to all components of courses, including, but not limited to, lectures, tutorials, and lab instruction, whether conducted by the instructor or teaching assistant, or other designated person. When recordings are permitted they are solely for the use

of the authorized student and may not be reproduced, or transmitted to others, without the express written consent of the instructor.

Section 8.3: Posting Course Materials on Websites

Posting any course materials, including lecture notes or experiment outlines, is strictly prohibited. These materials are copyright of the course instructors, Department of Physics and University of Guelph.

Section 9: Course Evaluation

Section 9.1: Course Evaluation

The Department of Physics requires student assessment of all courses taught by the Department. These assessments provide essential feedback to faculty on their teaching by identifying both strengths and possible areas of improvement. In addition, annual student assessment of teaching provides part of the information used by the Department's Tenure and Promotion Committee in evaluating the faculty member's contribution in the area of teaching.

The Department's teaching evaluation questionnaire invites student response both through numerically quantifiable data, and written student comments. In conformity with University of Guelph Faculty Policy, the Department's Tenure and Promotions Committee only considers comments signed by students (choosing "I agree" in question 14). Your instructor will see all signed and unsigned comments after final grades are submitted. Written student comments may also be used in support of a nomination for internal and external teaching awards.

Note: No information will be passed on to the instructor until after the final grades have been submitted.