

IPS*1510 Interdisciplinary Mathematics and Physics II

Department of Mathematics and Statistics; Department of Physics

Course Outline, Winter 2023

Instructors

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Course Description

Credit Weight: 1.0. This weighting should be reflected in your efforts and apportioned study time.

This is the second foundational course for students in B.Sc. mathematical and physical sciences majors. The disciplines of Mathematics and Physics are taught in an integrated fashion that demonstrates how they support and enrich one another. Circuits, integration, electrostatics, magnetism, partial derivatives, multidimensional integrals, and Taylor's series are presented in a harmonized fashion to ensure students have an improved understanding of these fundamentals.

Prerequisites: 4U Calculus and Vectors or equivalent, 4U Physics or PHYS*1020 or equivalent.

Restrictions: MATH*1080, MATH*1200, PHYS*1000. Restricted to B.Sc. students in APMS:C, BPCH, BPCH:C, BMPH, BMPH:C, CHPY, CHPY:C, CHEM, CHEM:C, MATH, NANO, NANO:C, PSCI, PHYS, PHYS:C, STAT, THPY

Course Objectives

The course is intended to give a student a grounding in topics in physics and calculus in a manner that uses the physics as an example to ground the calculus and provides the calculus

needed for the topics in physics. This integration of the two courses is intended to make both sets of material easier to absorb. Specific topics are listed subsequently under the heading Course Topics.

Meeting Times

Lectures

Class	Day	Time	Location
Math	Mo/Wed/Fr	11:30am-12:20pm	MACN 113
Physics	Mo/Wed/Fr	1:30-2:20pm	MACN 113

Labs/Tutorials Times**

Physics Labs/Tutorials

Section	Time	Location	Physics TA
0102	Tues. 11:30am-2:20pm	MACN 301	Bryn
0103	Thur. 11:30am-2:20pm	MACN 301	Victoria
0104	Wed. 7:00-9:50pm	MACN 301	Yasmeen
0105	Tues. 2:30-5:20pm	MACN 301	Josh

Math Tutorials

Section	Time	Location
01021, 01031, 01041, 01051	Fri. 4:30-5:20pm	MINS 103
01022, 01032, 01042, 01052	Tues. 10:30-11:20am	MCLN 107

****Physics quizzes are given during tutorials. The Math lab grade will be based on attendance.**

Course Materials

Required

- **University Physics, 14th or 15th Edition, Volumes 1, 2, and 3**, by H. Young and R. Freedman. This book is available in the University Bookstore.
- **Quick Start Calculus for Integrated Physics, Fourth Edition**, by D. Ashlock. This book is available in the University Bookstore and the Co-op Bookstore.
- **Online Homework (Achieve (formerly FlipItPhysics))**. There will be assigned warm-up questions that will be graded online, i.e., on the web, using Achieve Physics (see handout for more details). *Research has shown that this software has a positive effect on students learning of physics.* To complete the online homework, you will need to

purchase a stand-alone Student Access Kit for FlipItPhysics. The University Bookstore offers one semester access cards.

- The **Learning Management System** [CourseLink](#)

Recommended

Library Reference Material: There are many additional reference texts available on the library shelves. Look for call numbers beginning with QC21 or QC23 (Physics), QA155, QA303 (Math).

Course Themes

This course is divided into themes in order to emphasize some of the applications of physics and mathematics. The thematic approach is intended to give the material a grounding in the physical world outside of the classroom.

1. *Physics of electric charges*: This section will examine the nature of electric charge and charges in motion and at rest with applications to DNA molecules, electric dipoles, ion channels and membrane proteins, thunderstorms and the Large Hadron Collider.

2. *Charges at work*: Students will learn how to model and analyse electric charge behaviour in various real-world situations and how to analyse electric circuits using mathematical models.

3. *Medical imaging and therapy*: Students will gain an understanding and appreciation of the physical phenomena that underpins the medical Field e.g different types of spectroscopy and imaging techniques.

Evaluation

Assessment	Weight
Math Tutorials	10 %
Math Homework (5)	10 %
Physics Quizzes (4)	10 %
Online Prelectures & Practice (Achieve) (6-8)	5 %
Case Study	10 %
Laboratory Experiments (4)	10 %
Midterm x 2 (Dates TBA)	20 %
Final Exam (Apr. 24)	25 %
Total	100%

Math Tutorials

Mathematics tutorials will consist of a Q&A session with the TA. Your Math tutorial grade will be calculated based on attendance.

Math Homework

Assigned throughout the semester and due on Monday (unless Monday is a holiday, in which case the homework will be due on the following Wednesday). No late homework is accepted without appropriate justification. Work is to be submitted in lecture.

Physics Quizzes

During three of the physics tutorial periods (see schedule), after receiving help for 90 minutes you will write a short quiz via Courselink. Details regarding what the quizzes will cover will be provided during the semester.

Physics Online Homework

During the course of the semester there will be 6-8 online homework (FlipItPhysics) assignments for students to complete.

Case Study

There will be a case study exercise which will be completed individually. These integrated activities involve mathematically modelling simple and gradually more complex depictions of physical phenomena.

Laboratory Experiments

The physics lab experiments (see schedule below) are described in detail in the Lab handouts posted on CourseLink. Reports must be handed in using Jupyter Notebooks (Python).

Midterm Examination

Two in-person midterm exams will be held outside of class time in weeks 6 and 11 (exact date and time TBA). The midterms will consist of both multiple-choice questions and problems and each exam will be weighted at 10%. More details will be provided by your professors as the exam time approaches.

Final Examination

An in-person final examination will be held on Wednesday, April 24 from 11:30AM - 01:30PM. Details will be discussed during the semester. The exam will cover the entire course.

Physics Tutorial Periods

The tutorial periods will be devoted to the development of problem-solving skills.

Course Topics, by Week

Week	Physics Topic	Young and Freedman	Math Topics	Quick-Start
Jan. 9-13	Electric charges, forces, and fields	Ch 21	Differential Equations	9.1-9.2
Jan. 16-20	Electric force calculations	Ch 21	Differential Equations, Partial derivatives	9.3, 10.1
Jan. 23-27	Electric field calculations	Ch 21	Partial derivatives, gradients, directional derivatives	10.1-10.2
Jan. 30-Feb. 3	Work, Energy, Electric Potential	Ch 23	Tangent planes and optimization	10.3, 11.1
Feb. 6-10	Gauss' Law	Ch 22	Extreme Value Theorem	11.2
Feb. 13-17	Dipoles, Electric Flux, MIDTERM	Ch 21, 24	Constrained optimization, MIDTERM	11.3
Feb. 20-24	Winter Break (no classes)			
Feb. 27-Mar. 3	Capacitance, Dielectrics, Circuits	Ch 24, 25	Volumes of rotation, arc length	12.1-12.2
Mar. 6-10	Circuit analysis: Ohm's Law	Ch 25	Surface area, review of integration	12.2, Ch 7
Mar. 13-17	Circuit analysis: Kirchoff's Rules	Ch 26	Multiple integrals, center of mass	12.3
Mar. 20-24	Magnetism, Lorentz Force Laws	Ch 27	Sequences, geometric series	13.1
Mar. 27-31	Magnetic fields, Ampere's Law MIDTERM	Ch 28	Series-convergence tests MIDTERM	13.2
Apr. 3-10	Induction, Faraday-Lenz Law	Ch 29, 38	Power series, Taylor series	13.3-13.4

Getting Help

1. Your best source of help is your tutorial/lab instructor during the tutorial/lab period.
2. The course professors will be available to provide help (online for math, online or in person for physics) during their posted office hours. These will be announced in class and posted on Courselink. If you wish to obtain help from your professor at another time, please arrange a mutually convenient time via e-mail.
3. [Physics Tutorials](#)
Computer Tutorials: There are a number of physics tutorials available for you on the

Physics Department tutorial webpage:
www.physics.uoguelph.ca=tutorials=tutorials.html

Tentative Physics Tutorial/Lab Schedule

1	Jan. 9-13	N/A	
2	Jan. 16-20	Physics Lab 1: Electric field mapping	MacN 301
3	Jan. 23-27	Physics Quiz 1/Physics Tutorial	MacN 415
4	Jan. 30- Feb. 3	Physics Lab 2: Ohm's/Kirchoff's laws	MacN 301
5	Feb. 6-10	Physics Quiz 2/Physics Tutorial	MacN 415
6	Feb. 13-17	Physics midterm Review/ Midterm 1	MacN 415
	Feb. 20-24	Winter break – No classes/tutorials/labs	
7	Feb. 27- Mar. 3	Case Study Tutorial	MacN 415
8	Mar. 6-10	Physics Lab 3: Charge to mass ratio of electron	MacN 301
9	Mar. 13-17	Physics Quiz 3/Physics Tutorial / Case Study due	MacN 415
10	Mar. 20-24	Physics Lab 4: EKG lab	MacN 301
11	Mar. 27-31	Midterm Review/ Midterm 2	MacN 415
12	Apr. 3-10	Physics Quiz 4/Physics Tutorial	MacN 415

Course Statements

Collaboration versus Copying

Scientists work alone or in groups, very often consulting fellow scientists and discussing their research problems with peers. Collaboration is a feature of scientific activity and there are many benefits to working with others. However, no ethical scientist would ever publish or claim the work of others as his or her own and generally scientists give reference to the appropriate source of ideas or techniques which are not their own.

You are a young scientist and, in this spirit, I encourage you to discuss with others as you learn the material and work on the problem assignments. However, the work that you submit as your assignment must be your own and not a copy of someone else's work. Identical scripts will be given a mark of zero and plagiarism will be dealt with severely. I encourage you to cite your references, citing books and other articles when they are used and acknowledging discussions with those who have helped you in your understanding and completion of the problem. This is good scientific practice.

Student Feedback

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 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 Tenure and Promotions Committee only considers comments signed by students. 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.

University Statements

Email Communication

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

When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

[Undergraduate Calendar - Academic Consideration and Appeals](#)

[Graduate Calendar - Grounds for Academic Consideration](#)

[Associate Diploma Calendar - Academic Consideration, Appeals and Petitions](#)

Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

[Undergraduate Calendar - Dropping Courses](#)

[Graduate Calendar - Registration Changes](#)

[Associate Diploma Calendar - Dropping Courses](#)

Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

More information: www.uoguelph.ca/sas

Academic Integrity

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 encourages academic integrity. 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.

[Undergraduate Calendar - Academic Misconduct](#)
[Graduate Calendar - Academic Misconduct](#)

Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

[Academic Calendars](#)

Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

<https://news.uoguelph.ca/return-to-campus/how-u-of-g-is-preparing-for-your-safe-return/>
<https://news.uoguelph.ca/return-to-campus/spaces/#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.