# IPS*1510 Interdisciplinary Mathematics and Physics II

Department of Mathematics and Statistics. Department of Physics

## Course Outline - Winter 2022

### Instructors

| Name | Office | Email |
|------|--------|-------|
| Daniel Kraus (math) | MacNaughton 511 | dkraus@uoguelph.ca |
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### Teaching Assistants

| Name | Email |
|------|-------|
| Rocky Narang (math) | rnarang@uoguelph.ca |
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## Disclaimers

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email. This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website and circulated by email.

The University will not normally require verification of illness (doctor's notes) for fall 2021 or winter 2022 semester courses. However, requests for Academic Consideration may still require medical documentation as appropriate.

By enrolling in a course, unless explicitly stated and brought forward to their instructor, it is assumed that students agree to the possibility of being recorded during lecture, seminar or other \live" course activities, whether delivery is in-class or online/remote. If a student prefers not to be distinguishable during a recording, they may:

- turn off their camera
- mute their microphone
- edit their name (e.g., initials only) upon entry to each session
- use the chat function to pose questions.

Students who express to their instructor that they, or a reference to their name or person, do not wish to be recorded may discuss possible alternatives or accommodations with their instructor.

Inappropriate online behaviour will not be tolerated. Examples of inappropriate online behaviour include:

- Posting inflammatory messages about your instructor or fellow students
- Using obscene or offensive language online
- Copying or presenting someone else's work as your own
- Adapting information from the Internet without using proper citations or references
- Buying or selling term papers or assignments
- Posting or selling course materials to course notes websites
- Having someone else complete your quiz or completing a quiz for/with another student
- Stating false claims about lost quiz answers or other assignment submissions
- Threatening or harassing a student or instructor online
- Discriminating against fellow students, instructors and/or TAs
- Using the course website to promote profit-driven products or services
- Attempting to compromise the security or functionality of the learning management system
- Sharing your user name and password
- Recording lectures without the permission of the instructor

## 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

**NOTE: The first two weeks' worth of lectures, labs, and tutorials will be online only.**

**Lectures**

| Class | Day | Time | Location |
|---|---|---|---|
| Math | Mo/Wed* | 10:30am-11:20am | MCKN 117 |
| Physics | Mo/Wed/Fr | 1:30pm-2:20pm | MACN 113 or Zoom (live) |

*One or more videos will be posted to Courselink each week to account for a third math lecture*

**Labs/Tutorials Times\*\***

**Physics Labs/Tutorials**

| Section | Time | Location |
|---|---|---|
| 01021, 01022 | Tues. 11:30am-2:20pm | MACN 301/415 |
| 01031, 01032 | Thur. 11:30am-2:20pm | MACN 301/415 |

**Math Tutorials**

| Section | Time | Location |
|---|---|---|
| 01021, 01031 | Tues. 8:30am-9:20am | MACS 121 |
| 01022, 01032 | Tues. 2:30pm-3:20pm | MACS 121 |

*\*\*Math & Physics quizzes are given during tutorials*

## Course Materials

**Required**

- **University Physics, 14th or 15th Edition, Volumes 1, 2, and 3**, by H. Young and R. Freedman (this will also be used in IPS*1510 in Winter 2022). This book is available in the University Bookstore.
- **Quick Start Calculus for Integrated Physics, Fourth Edition**, by D. Ashlock (this is the same book that was used in IPS*1500 in Fall 2021). This book is available in the University Bookstore and the Co-op Bookstore.
- **Online Homework (FlipItPhysics (formerly smartPHYSICS))**. There will be assigned warm-up questions that will be graded online, i.e., on the web, using FlipIt 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 (or two semester cards for students going on to IPS*1510 in the Winter).
- **i-Clicker/Reef Student Response Systems** (commonly known as clickers): You can purchase a license for compatible smartphones through the University Bookstore. The use of the iClicker reef system is not mandatory this year.
- 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 Quizzes (10) | 10 % |
| Math Homework (10) | 10 % |
| Physics Quizzes (4) | 12 % |
| Online Homework (smartPHYSICS) (6-8) | 5 % |
| Case Study | 8 % |
| Laboratory Experiments (4) | 15 % |
| Midterm | 15 % |
| Final Exam | 25 % |
| Total | 100% |

**Math Quizzes**

Mathematics tutorials will consist of a game in which students cooperate in teams to solve problems. The rules are available on Courselink. You will accumulate points over the course of the semester towards your "Math Quiz" grade.

**Math Homework**

Assigned weekly, 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**

An in-person midterm exam will be held outside of class time in week 6 (exact date and time TBA). The midterm will consist of both multiple-choice questions and problems. 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 20 from 2:30pm-4:30pm. 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 (tentative)

| Week | Physics Topic | Young and Freedman | Math Topics | Quick-Start |
|---|---|---|---|---|
| Jan. 10-14 | Electric charges, forces, and fields | Ch 21 | Review, partial derivatives | 2.5, 10.1 |
| Jan. 17-21 | Electric force calculations | Ch 21 | Partial derivatives, gradients, directional derivatives | 10.1-10.2 |
| Jan. 24-28 | Electric field calculations | Ch 21 | Tangent planes and optimization | 10.3, 11.1 |
| Jan. 31-Feb. 4 | Work, Energy, Electric Potential | Ch 23 | Extreme value theorem | 11.2 |
| Feb. 7-11 | Gauss' Law | Ch 22 | Constrained optimization | 11.3 |
| Feb. 14-18 | Dipoles, Electric Flux, **MIDTERM** | Ch 21, 24 | Volumes of rotation, arc length, **MIDTERM** | 12.1-12.2 |
| Feb. 21-25 | Winter Break (no classes) | | | |
| Feb. 28-Mar. 4 | Capacitance, Dielectrics, Circuits | Ch 24, 25 | Surface area, review of integration | 12.2, Ch 7 |
| Mar. 7-11 | Circuit analysis: Ohm's Law | Ch 25 | Multiple integrals, center of mass | 12.3 |
| Mar. 14-18 | Circuit analysis: Kirchhoff's Rules | Ch 26 | Sequences, geometric series | 13.1 |
| Mar. 21-25 | Magnetism, Lorentz Force Laws | Ch 27 | Series-convergence tests | 13.2 |
| Mar. 28-Apr. 1 | Magnetic fields, Ampere's Law | Ch 28 | Power series, Taylor series | 13.3-13.4 |
| Apr. 4-8 | Induction, Faraday-Lenz Law | Ch 29, 38 | Review and reflection | all chapters |

## 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. 10-14 | N/A | |
|---|---|---|---|
| 2 | Jan. 17-21 | Physics Tutorial / Case Study Help | MacN 415 |
| 3 | Jan. 24-28 | Physics Lab 1: Electric field mapping | MacN 301 |
| 4 | Jan. 31- Feb. 4 | Physics Quiz 1 | MacN 415 |
| 5 | Feb. 7-11 | Midterm prep /Case Study: Data Collection/Analysis | MacN 301 |
| 6 | Feb. 14-18 | Physics Tutorial/ **Midterm** | MacN 415 |
| | Feb. 21-25 | **Winter break – No classes/tutorials/labs** | |
| 7 | Feb. 28- Mar. 4 | Physics Lab 2: Ohm's/Kirchoff's laws | MacN 301 |
| 8 | Mar. 7-11 | Physics Quiz 2 | MacN 415 |
| 9 | Mar. 14-18 | Physics Lab 3: Charge to mass ratio of electron/ Case Study due | MacN 301 |
| 10 | Mar. 21-25 | Physics Quiz 3 | MacN 415 |
| 11 | Mar. 28-Apr. 1 | Physics Lab 4: EKG lab | MacN 301 |
| 12 | Apr. 4-8 | Physics Quiz 4 | 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

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration

https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

## 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

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes

https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-regregchg.shtml

Associate Diploma Calendar - Dropping Courses

https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml


## 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 book their exams at least 14 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website

https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website

https://www.ridgetownc.com/services/accessibilityservices.cfm

## 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

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-

amisconduct.shtml

Graduate Calendar - Academic Misconduct

https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

## 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

https://www.uoguelph.ca/academics/calendars

## Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-yoursafe-return/

https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces

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