IPS*1500 Interdisciplinary Mathematics and Physics

Department of Mathematics and Statistics; Department of Physics

Course Outline

Fall 2015 Course

	Name	Office	e-mail
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Course Description:

This is a 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. Atomic structure, algebra and trigonometry, forces and Newton's laws, functions and graphing, differentiation, angular momentum and energy conservation, limits, integration, kinematics, simple harmonic motion, and special relativity 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*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 topics is intended to make both sets of material easier to absorb. Specific topics are listed subsequently under the heading *Course Topics*.

Meeting Times

Lectures: **Math:** 10:30-11:20 in **Landscape Architechture 204**, **Physics:** 1:30-2:20 in **Landscape Architecture 204**

Lab Times		
Section	Time	Location
0101	Tues. 8:30-11:20	MacNaugton 301/401
0102	Thur. 8:30-11:20	MacNaugton 301/401
0103	Wed. 2:30-5:20	MacNaugton 301/401
0104	Tues. 7:00-9:50	MacNaugton 301/401
0105	Tues. 8:30-11:20	MacNaugton 301/401
0106	Thur. 8:30-11:20	MacNaugton 301/401
0107	Wed. 2:30-5:20	MacNaugton 301/401
0108	Tues. 7:00-9:50	MacNaugton 301/401
Mathematics Tutorial Times*		
0101-0104	Tues. 11:30-12:20	Crop Science 117
0105-0108	Fri. 12:30-1:20	Crop Science 116

*Math quizzes are given during the math tutorial

Course Materials

University Physics, 13th Edition, Volumes 1, 2, and 3, by *H. Young and R. Freedman* (this will also be used in IPS*1510 in Winter 2015). This book is available in the University Bookstore.

Calculus, 7th Edition, by *J. Stewart* (this will also be used in IPS*1510 in Winter 2015). This book is available in the University Bookstore.

Online Homework (smartPHYSICS). There will be assigned warm-up questions that will be graded online, i.e., on the web, using smartPhysics (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 smartPhysics. The University Bookstore offers one semester access cards (or two semester cards for students going on to IPS*1510 in the Winter).

i-Clicker Student Response Units (commonly known as *clickers*) are available for purchase in the University Bookstore.

Library Reference Material

Available at the Reserve Desk in the Library, listed under Prof. M. Williams/Prof. D. Ashlock and course IPS*1500, are the following:

- a copy of the course textbooks
- Study Guide to accompany University Physics, Volumes I, II, and III.

As well, 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. Becoming a Scientist (Weeks 1-2) This section will emphasize the scientific method, the importance of errors and error propagation in experiments, and introduce students to basic statistical quantities such as the mean and standard deviation. An inquiry-based laboratory exercise has been designed to allow students to explore the differences between random and systematic errors, and become familiar with calculating statistical quantities from experimental data.
2. Sport (Weeks 2-6) Physical activity is an important part of a healthy lifestyle; we will connect healthy living to physics and mathematics by showing examples of physics concepts such as kinematics, forces, circular motion, and torque in sports. A calculus-based approach will be used for solving problems.
3. Natural Phenomena (Weeks 6-10) An understanding and appreciation for the world and materials around us is the emphasis of this section. This section will discuss the enormous energy provided by the sun, fluid dynamics and the flow of water through rivers, compare man-made and natural materials such as steel and spider-silk, and look at nanomaterials which are used to explain certain phenomena such as how geckos can climb walls.
4. Space travel (Weeks 11-12) People have always been fascinated by space: the planets, stars, galaxies, etc. In this part of the course, we explore circular motion and forces in terms of objects orbiting about one another. We also introduce the concept of special relativity (specifically time dilation, and length contraction) which was proposed by Albert Einstein in 1905.

Evaluation

Assessment	Weight
Math Quizzes (9)	10 %
Math Homework (9)	10 %
Physics Quizzes (3)	9 %
Online Homework (smartPHYSICS) (4-6)	5 %
Case Studies (2)	8 %
Laboratory Experiments (5)	18 %
Midterm 1	10 %
Midterm 2	10 %
Final Exam	20 %
Total	100%

Math Quizzes: Mathematics tutorials will start with a brief 10-15 minute quiz. The instructor will then give the solution to the quiz and the remainder of the period will be available for tutorial help. Quiz topics will be on material covered in the three class days before the tutorial.

Math Homework: Assigned weekly. 3-5 starred problems to be turned in on Fridays in class. Homework covers material from previous weeks.

Physics Quizzes: During three of the tutorial periods (see schedule), after receiving help for 90 minutes you will write a 30-minute quiz. Details regarding what the quizzes will cover will be provided on Weekly Guides during the semester. These tutorials will be held in MacN 401.

Online Homework: During the course of the semester there will be 5-6 online homework (smartPHYSICS) assignments for students to complete.

Case Studies: There will be two case studies which will be completed individually. These are integrated activities which involve mathematically modelling a simple and gradually more complex depictions of physical situations.

Laboratory Experiments: The laboratory experiments (see schedule) are described in detail in the Laboratory Manual which is provided online as a pdf file on CourseLink. Experiments are to be completed and reports handed in during the laboratory period. The laboratory experiments will be done in MacN 301. If you miss a quiz or a lab, you must provide **your TA** with a written explanation for possible academic consideration.

Midterm Examinations: The midterm examinations will be held outside of class on two Friday evenings on Fri. Oct. 10 and Fri. Nov. 14. Both will be held in Rozanski Hall room 102. More details (time and material covered) will be provided as the semester progresses.

Final Examination: The final examination will be held on Thursday, Dec. 17 from 8:30-10:30am. The location will be provided during the semester. The exam will cover the entire course.

Tutorial Periods: The tutorial periods will be devoted to the development of problem-solving skills in addition to the quizzes in the math tutorial.

Course Topics, by Week

Week	Physics topics	Young and Freeman	Math topics	Stewart
Sept. 11 and 14-18	The scientific method, measurement and error, error analysis	Ch 1.1-1.6 Laboratory Manual Taylor (Error Analysis)	Algebra and the library of functions	1.2, 2.1, 2.1, 3.3
Sept. 21-25	Motion, 1-D kinematics	Ch 1.3, 1.7-1.10, 2	Derivative rules, limits and continuity, curve sketching	2.2,2.3,2.5,3.2-3.6
Sept. 28-Oct.2	1-D kinematics, 2-D kinematics, causes of motion - forces	Ch 2, 3, 4	Max-min problems, the fundamental theorem, integration	4.1, 5.1-5.3, 5.5
Oct. 5-Oct. 9	Newton's laws, friction, relative motion	Ch 3, 4, 5	Vectors, vector functions, theory of continuity and derivatives	12.1-12.3 and 2.4-25.
Oct. 12-16	Circular motion, introduction to energy	Ch 3, 6	Parametric and polar curves, tangents, normal vectors, line integrals	8.1,10.1-10.3,13.1-13.2
Oct. 19-23	(Oct. 12 Thanksgiving, Oct. 13 Fall Study Break Day) Conservation of energy, momentum, impulse and collisions	Ch 6, 7, 8	Review of linear systems, coordinate systems, least squares lines	None
Oct. 26-30	Rotational motion	Ch 9	Mean value theorem, max-min again, LaHospital and curve sketching	4.1, 4.2, 4.4, 4.5
Nov. 2-6	Rotational energy, moment of inertia	Ch 9	Cross products, orthogonality, definite integrals and techniques	7.1, 7.3, 12.4
Nov. 9-13	Torque, angular momentum, equilibrium and elasticity, fluid statics	Ch 10, 11, 12	Formal treatment of derivatives and continuity; logarithmic derivatives	2.4,2.5,2.7,2.8
Nov. 16-20	Fluid mechanics, materials/nanomaterials	Ch 12	Review to this point, differential equations	17.1
Nov. 23-27	Kinematics revisited-simple harmonic motion, special relativity	Ch 14, 37	Differential equations	17.1, 17.2, 17.3
Nov. 30-Dec 4.*	Special relativity, exam review	Ch 37	Review and reflection	None (or all)

*Dec 3, Tuesday schedule, Dec 4, Monday schedule

Getting Help

1. Your best source of help is your tutorial/lab instructor during the tutorial/lab period.
2. In most of the ten physics lab/tutorial periods, the activities are completed in the first two and a half hours, and hence the lab/tutorial instructor usually has a great deal of time in the final 30 minutes to help students. Please feel free to drop in during the final 30 minutes of any of the tutorial periods to obtain help.
3. The math-stats and physics learning centers on the 3rd floor of the library is available for help during their posted hours.
4. The course professors will be available to provide help in their offices (Physics: MacN 213, Math: MacN 521) during their posted office hours. These are given on the class web site *http://eldar.mathstat.uoguelph.ca/dashlock/IPS1500/*. If you wish to obtain help from your professor at another time, please see him before or after lectures to arrange a mutually convenient time. Short questions can often be handled in the lecture room just before or after lectures.
5. Computer Tutorials: There are a number of physics tutorials available for you on the Physics Department tutorial webpage (www.physics.uoguelph.ca/tutorials/tutorials.ht Of particular usefulness in this course are the tutorials on: Algebra (review), Significant Digits Unit Conversions Trigonometry (review), Free-Body Diagrams Graphing Log Paper Vectors (review), Torque and Rotational Motion, Dimensional Analysis, and Simple Harmonic Motion

Physics Tutorial/Lab Schedule:

Week	Dates (Tu/Wed/Th)	Tutorial/Lab	Location
1	Sept. 14-18	Lab 1: Error analysis	MacN 301
2	Sept. 21-25	Lab 2: Introduction to the use of Motion Sensors and Capstone	MacN 301
3	Sept. 28-Oct. 2	Tutorial, Physics Quiz 1, Case Study 1 handed out	MacN 401
4	Oct. 5-9	Lab 3: Acceleration due to Gravity	MacN 301
5	Oct. 12-16	Midterm Help Sessions and Case Study 1 Help	MacN 401
6	Oct. 19-23	Holiday Monday/Tuesday No Tutorial/Lab, Case Study 1 Due, Case Study 2 handed out	
7	Oct. 26-30	Case Study 2 Help Session	MacN 401
8	Nov. 2-6	Tutorial, Physics Quiz 2	MacN 401
9	Nov. 9-13	Lab 4: Torque and Angular Momentum	MacN 301
10	Nov. 16-20	Lab 5: Simple Harmonic Motion, and Midterm Help Sessions	MacN 301
11	Nov. 23-27	Tutorial, Physics Quiz 3, Case Study 2 Due	MacN 401
12	Nov. 30-Dec. 4	Exam preparation times TBA.	MacN 401

*Nov. 29 Monday schedule

Rights and Responsibilities

Conflicts with Midterms in Other Courses. Sometimes students will have a 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 2012-2013 Undergraduate Calendar *http://www.uoguelph.ca/registrar/calendars/undergraduate/2012-2013/* in Section VIII–Undergraduate Degree Regulations and Procedures under the heading *Examinations* (sub-heading *Mid-Term Examinations*.

Formula Sheet. You may bring a single normal sheet of printer or notebook paper with notes and formulas on both side to examinations including the math lab quizzes. A formula sheet will not be provided as part of the examinations.

Attendance: Illness, etc.: Attendance at the tutorial/lab periods is, of course, very important. If you miss a tutorial quiz or laboratory experiment because of illness or for compassionate reasons, please see your laboratory/tutorial instructor for possible academic consideration. If you miss the midterm exam, please see a course professor. If you miss the final exam, please see your Program Counsellor. For more details, refer to the Undergraduate Calendar: *http://www.uoguelph.ca/registrar/calendars/undergraduate/2012-2013/* – go to *Section VIII Undergraduate Degree Regulations and Procedures*, and click on the heading *Academic Consideration, Appeals and Petitions.*

Collaboration: This course encourages collaborative teamwork, a skill that is an essential feature of science, and valued by most employers. Scientists and engineers work in groups as well as alone. Social interactions are critical to their success! Most good ideas grow out of discussions with colleagues. As you study together, help your partners to get over confusions, ask each other questions, and critique your assignments and lab write-ups. Teach each other. You can learn a great deal by teaching. While students are encouraged to share ideas, all material submitted for grading must be each student's own work. Plagiarism is a form of academic misconduct, and will not be tolerated.

Course Feedback: Both sponsoring departments require student assessments of all courses taught by the departments. 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.

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 the course, 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.

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:

https://www.uoguelph.ca/registrar/calendars/undergraduate/2015-2016/c08/c08-amisconduct.shtml

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 Centre for Students with Disabilities as soon as possible. For more information, contact student accessibility services at **519-824-4120 ext. 56208** or email **sas@uoguelph.ca** or see the website: **http://www.csd.uoguelph.ca/csd/**

Drop date

The last date to drop one-semester courses, without academic penalty, is November 6th, 2015. For regulations and procedures for Dropping Courses, see the Academic Calendar:

https://www.uoguelph.ca/registrar/calendars/undergraduate/2015-2016/c08/c08-drop.shtml