PHYS 1P21/91

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Calendar entry

Brightspace

Introductory Physics I: Course Outline

1. What is this course all about?

Brock calendar entry: Kinematics, Newton's laws and their applications to equilibrium and dynamics; conservation laws; oscillations, waves, and sound.

Overview

Mechanics is about motion, which is fundamental in physics, and this course provides an introduction to understanding motion. Mechanics can be separated into two aspects, kinematics (the mathematical description of motion) and dynamics (which explains the detailed causes of motion, and quantifies their effects). Newtonian mechanics is an extremely successful theory for describing and explaining many phenomena in our every-day experience. Using Newtonian mechanics, we have been able to construct bridges, towers, homes, tall buildings, machines, and so on, and they work beautifully as expected. Airplanes, trains, cars, and even spacecraft all work well, and arrive at planned destinations, in accord with Newtonian mechanics.

However, understanding the inner workings of electronic devices (such as computers, smart phones, etc.), lasers, solar cells, the interiors of molecules, atoms, and atomic nuclei, energy production in the sun and stars, and all manner of other exotic phenomena, requires a deeper understanding of mechanics that only became known in the 20th century: quantum mechanics. Broadly speaking, Newtonian mechanics is an excellent theory for the macroscopic world, and quantum mechanics is essential for understanding the microscopic world. (However, this is an oversimplification, because lasers and smart phones are macroscopic, but I hope you get the idea.)

For objects that travel relatively slowly, such as baseballs, humans, and rocketships, Newtonian mechanics provides an excellent description. For objects that travel extremely fast, at a significant fraction of the speed of light, another theory of mechanics is necessary for an adequate description and explanation: relativistic mechanics (the special theory of relativity).

For an introduction to relativity, and for quantum mechanics and its applications, you'll have to stick around for second-year physics and beyond. If you wish to go further in physics, or in any of the sciences that depend on physics (and which don't?), work hard now to provide yourself with a solid foundation, and you'll be able to take your studies as far as you wish.

What do I need to bring into the course?

This course is suitable for students with a high school science background. High school calculus or physics are *not* required, but good skills in elementary algebra, geometry, and trigonometry at the high-school level are necessary; this course is *quantitative* in nature. A good scientific calculator is essential.

Textbook

The textbook is *College Physics*, second edition, by Urone, Hinrichs, Dirks, and Sharma, published by OpenStax (Rice University), and available to download for free at http://cnx.org. A solution manual and other student resources are available at https://openstax.org/details/college-physics.

Some people like to have secondary sources to read in case they have difficulty understanding the primary textbook in some places. This is NOT required, but if you would like a secondary source, you can also consult the more advanced Openstax University Physics, which is also available for free.

You can also borrow other textbooks from a library, or buy an inexpensive used algebra-based textbook from your favourite used bookstore or internet source. Look for titles such as *Physics* or *College Physics*. If your major subject is Physics or a related field, and you would like a more advanced (say, calculus-based) textbook for reference, look for titles that include "for Scientists and Engineers." If you are considering buying a secondary textbook, and are not sure if it will be appropriate for you, send me an email message and I'll advise.

PPLATO

PPLATO is a set of online resources organized as a full-scale physics and mathematics textbook. There are two types of resources: in the left column there are FLAP (Flexible Learning Approach to Physics), while on the right are supplementary self-assessment modules. Think of the left-hand column as of the chapters of a complete textbook, and of the right-hand column as of tutorials on a selection of topics. I'll refer to PPLATO during the course, but if you need a reminder of some basic mathematics, this is a good place to go first.

Homework

Doing a sufficient amount of homework, and doing it regularly and in the right way, is essential for success in this course. Homework is not graded in this course, but if you expect to succeed, doing your homework effectively is important.

One element of doing your homework is to read your textbook in advance of the lectures. Coming to lectures well-prepared will accelerate your progress. It's not necessary to understand everything before coming to lectures, but having some understanding primes your brain to learn effectively in lecture. Make a note of the things that you don't understand, and review them just before lecture. In this way you will be alert for the answers to your specific questions during lectures.

Trying a few practice problems before lectures is also helpful for the same reason. After lectures, try more practice problems. Good sources of practice problems are the lecture notes and the examples in the textbook, because the fully-worked out solutions are given. An effective way to practice is to try solving the problems on your own, without looking at the solutions. If you get stuck, then peek at the solution, get unstuck, then cover up the solution again and try to continue. If you get stuck again, peek again. Repeat this process often enough until you get through the solution. At your next study session, start by repeating any problems that you had difficulty completing on your own, using the same method. With enough repetition, you will eventually be able to solve the problem on your own, without looking at the solution. Do this for a sufficient number of problems, and you will be well-prepared for tests and the final exams. The repetition also helps place your learning in your long-term memory. The goal is not to memorize how to solve any specific problem, but rather a much higher goal. The goal is to internalize good problem-solving methods and habits, so that you are well-prepared to solve problems in general, even those that you haven't solved before. Regular repetition is key to this learning process; do your daily work!

Another good source of problems is Brock's WeBWork homework system. Most of the problems in our textbooks have been placed on this system, and although full solutions are not available, you have immediate access to the answers for each problem. To access WeBWorK, click on https://webwork.brocku.ca/webwork2/PHYS1P21PHYS1P91D03FW2022/ and log on using your Brock username (of the form ab23cd, DO NOT include the @brocku.ca) and your usual Brock password. Once you have logged on, you will find the homework sets for the course, organized by chapter. There is also an "Introduction to WeBWorK" homework set that you can work through to help you learn how to use the system.

Some students take short-cuts with their homework, by simply "googling" the answers. Typically such students fail the course. There are no shortcuts, and no magic formulas for success. It's very simple: Daily, consistent, honest work leads you to success.

Academic Integrity

Academic misconduct is a serious offence. The principle of academic integrity, particularly of doing one's own work, documenting properly (including use of quotation marks, appropriate paraphrasing and referencing/citation), collaborating appropriately, and avoiding misrepresentation, is a core principle in university study. Students should consult Section VII, "Academic Misconduct", in the "Academic Regulations and University Policies" entry in the Undergraduate Calendar, available here, to view a fuller description of prohibited actions, and the procedures and penalties.

A helpful web site describes Brock's academic integrity policy. Please read it carefully, as all students are expected to understand it and abide by its provisions.

2. Lectures, Labs, and Tests

Instructor: S. D'Agostino

Lectures: Mondays, Wednesdays, and Thursdays 12–12:50 pm in Room STH 204.

Tests:

Tests are written most Mondays from 11–11:50 am in Room TH 325.

PHYS 1P91 Laboratory

All information about the laboratory portion of this course is available at our Brightspace course page.

An integral part of the labs is the use of **computer-based data acquisition**; you may wish to consult https://www.physics.brocku.ca/physica/ in advance. Under the "Get data" menu selection, select "demo" and click "go"; the demo mode allows you to try the tools without being in the lab.

Where to go if you need help with labs:

If you have any questions about anything regarding the laboratory portion of this course, then please see the lab instructor, Mr. Phil Boseglav (Room MC B211), or the lab supervisor/instructor Dr. Ivana Komljenović-Metcalf (Room MC B210A), or send an email message to phys1p91@brocku.ca.

3. Sources of help

Office hours for January--April 2023: S. D'Agostino, Room MC E203, Wednesdays 9–11 am.

PHYSICS HELP DESK: Run by physics graduate students in Room MC H200, every week except Reading Week; the schedule is as follows:

- Tuesdays 12--2 pm
- Wednesdays 2--3 pm
- Fridays 9--10 am and 12--2 pm

Falling behind in a mathematics or science course leads to extreme difficulties, because university mathematics and science courses are extremely fast-paced compared to high-school courses, and because typically each week's new course content depends on course content from previous weeks. Don't allow yourself to fall behind! Consistent, daily work will help you to succeed in the course.

I encourage you to visit my office whenever you would like to discuss physics. Don't wait until the last moment; make sure you clear up anything that is unclear as soon as possible, as this will make your studies more effective and you will go further in less time.

Online electronic documentation

This course description, some lecture notes, and some study aids are available online via the Web server of the Physics Department, https://www.physics.brocku.ca/ (follow the links to Courses ---> 1P21/1P91).

4. Topics to be studied

As time permits, some topics not listed below may be added, while some other topics may not be discussed during lectures. The outline below is only an approximation.

» Chapter 1: Introduction: The Nature of Science and Physics
  » significant figures
  » scientific notation
  » physical quantities and units; converting from one unit to another unit

» Chapter 2: Kinematics in One Dimension
  » kinematics vocabulary; position and displacement, speed and velocity, acceleration
  » position-time graphs; velocity
  » position-time graphs and velocity-time graphs
  » uniform motion
  » instantaneous velocity and average velocity
  » acceleration; acceleration-time graphs
  » acceleration due to gravity
  » kinematics equations for motion with constant acceleration
  » free fall

» Chapter 3: Kinematics in Two Dimensions
  » coördinate systems
  » kinematics in two dimensions
  » vectors and their components
  » graphical and analytical methods for adding and subtracting vectors
  » projectile motion
  » relative motion; addition of velocities

» Chapter 4: Forces and Newton's Laws of Motion
  » dynamics; the concept of a force
  » Newton's first law of motion
  » Newton's second law of motion
  » free-body diagrams

- » Newton's third law of motion
- » types of forces
- » gravitational forces
- » normal forces
- » static and kinetic frictional forces
- » tension forces
- » equilibrium applications of Newton's laws of motion
- » non-equilibrium applications of Newton's laws of motion
- » an introduction to the four fundamental forces

» Chapter 5: Further Applications of Newton's Laws
- » friction
- » drag
- » OMIT: ~~elasticity: stress and strain~~

» Chapter 6: Uniform Circular Motion and Gravitation
- » rotation angle and angular velocity
- » uniform circular motion
- » centripetal acceleration
- » centripetal force
- » fictitious forces and non-inertial frames: Coriolis forces
- » Newton's law of gravity
- » satellite orbits
- » Kepler's laws of orbital motion

» Chapter 7: Work, Energy, and Energy Resources
- » work done by a constant force
- » the work-energy theorem and kinetic energy
- » gravitational potential energy
- » conservative and nonconservative forces
- » the principle of conservation of mechanical energy
- » nonconservative forces and the work-energy theorem
- » the principle of conservation of energy
- » power
- » work, energy, and power in humans
- » world energy use

» Chapter 8: Linear Momentum and Collisions
- » linear momentum and force
- » the impulse-momentum theorem
- » the principle of conservation of linear momentum
- » collisions in one dimension
- » collisions in two dimensions
- » OMIT: ~~rocket propulsion~~

» Chapter 9: Statics and Torque
- » conditions for equilibrium
- » stability
- » applications of statics
- » simple machines
- » forces and torques in muscles and joints

» Chapter 16: Oscillatory Motion and Waves
- » Hooke's law
- » period and frequency in oscillations
- » simple harmonic motion
- » OMIT: ~~simple pendulum~~
- » energy in simple harmonic oscillations
- » comparing uniform circular motion and simple harmonic motion
- » damped harmonic motion
- » forced oscillations and resonance
- » waves
- » superposition and interference
- » energy in waves: intensity

» Chapter 17: Sound
- » sound
- » sound speed, frequency, and wavelength

» sound intensity and sound level
» Doppler effect and sonic booms
» sound interference and resonance; standing waves in air columns
» hearing
» ultrasound

5. Course Schedule

Week	Dates	Lectures	Test	Test Dates
1	9 Jan.–13 Jan.	Ch 1 and Ch 2	NO TEST	
2	16 Jan.–20 Jan.	Ch 2	NO TEST	
3	23 Jan.–27 Jan.	Ch 3	Ch 2	23 Jan.
4	30 Jan.–3 Feb.	Ch 4	Ch 3	30 Jan.
5	6 Feb.–10 Feb.	Ch 4 and Ch 5	Ch 4 (Concepts)	6 Feb.
6	13 Feb.–17 Feb.	Ch 5	Ch 4 (Calculations)	13 Feb.
READING WEEK	20 Feb.–24 Feb.	READING WEEK	NO TEST	
7	27 Feb.–3 Mar.	Ch 6	Ch 5	27 Feb.
8	6 Mar.–10 Mar.	Ch 7	Ch 6	6 Mar.
9	13 Mar.–17 Mar.	Ch 8	Ch 7	13 Mar.
10	20 Mar.–24 Mar.	Ch 9	Ch 8	20 Mar.
11	27 Mar.–31 Mar.	Ch 16	Ch 9	27 Mar.
12	3 Apr.–6 Apr.	Ch 17	Ch 16	3 Apr.

6. Grading Scheme

Component	PHYS 1P21	PHYS 1P91	Comments
Tests	60%	45%	Each test may contain material discussed in earlier weeks.
Final Exam	40%	35%	**You must score at least 50% on the final exam to obtain a credit in the course**.
Laboratory Work	—	20%	Completing all labs and submitting all written lab reports are required to complete the lab component of the course. Students receiving an overall lab grade that is less than 60% will be required to withdraw from PHYS 1P91, and will only be able to receive a grade in PHYS 1P21.

You may bring a simple scientific calculator (no graphics or programmable calculators) to each test and the final exam. A copy of the formula sheet will be included in the test script. Don't bring your own copy of the formula sheet. No other aids are permitted. Grades are awarded on tests and the final exam for correct answers and correct reasoning; show your work! Any formulas used that are not on the formula sheet must be derived; otherwise a grade of zero for the problem will be assigned.

In calculating your overall test score, each test carries equal weight. If you miss a test, and you have a very good reason (documentation is required and must be presented in person), you will be excused from the missed test with no academic penalty (i.e., you'll get a "no mark"). The weight of excused tests will be distributed proportionally to the other tests.

If you miss the final exam for a very good reason (documentation is required and must be presented in person), then you will need to write a make-up exam to get a credit in the course, unless your situation is truly extreme. Final exam periods tend to be extremely busy, so there is no guarantee that it will be possible to write a make-up exam soon after the scheduled final exam.

If you obtain less than 50% on the final exam, and therefore do not obtain a credit in the course (regardless of your calculated final grade), the Registrar's Office will report a final grade for you that is either your calculated final grade or 45, whichever is less, according to Brock University policy. In this case, should you desire a credit in the course, you would have to repeat the course.

Withdrawal Deadline

The last date for withdrawal from this course without academic penalty is Friday 10 March, 2023.

7. Expectations/Responsibilities

Here is a summary of our expectations of you, which are your responsibilities. You are expected to:

- attend each scheduled lecture and laboratory session.
- do your work honestly.
- attend lectures having **prepared in advance** by reading relevant parts of the textbook, and completing the pre-lecture homework assignment. You are also expected to bring pencil and paper to lectures so that you are ready to work during the session.
- attend labs having **prepared in advance** by reading relevant parts of the lab manual, and having completed the prelab problems.
- attend each test, with only a non-graphics calculator and writing instruments. Don't bring your formula sheet, as we'll give you one.

To get the most out of the course, work on it a little bit every day. Daily work is key for placing your learning in long-term memory, where it will be readily available to help you to advance your knowledge in second year and beyond. (And, of course, having the course content in long-term memory will help you ace the final exam!)

Prepare for each lecture by reading the textbook, trying some homework problems, and writing down specific questions about points that you find difficult. If you do this, you will be very pleased with the results.

The same kind of advice applies to the laboratories as well. If you attend lab superbly well-prepared, then you will be extremely efficient, you will collect your data successfully, and you will even be able to complete some of your lab report in the lab. You will be especially efficient because you will be able to ask your lab demonstrators good questions **while you are in the lab**, and this will help you to complete your lab report efficiently.

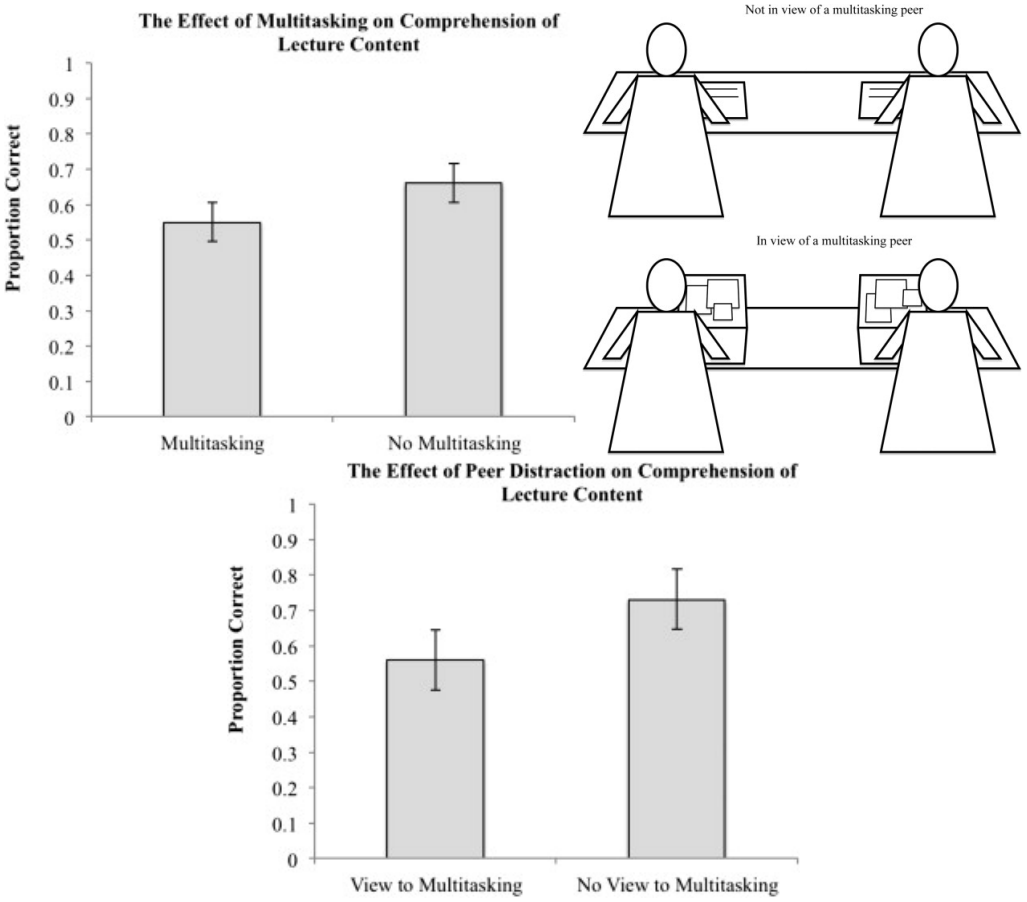
Remember, it is impossible for your course instructor to effectively cover an entire chapter of the textbook in less than three hours of lectures per week. It is your responsibility to learn the course material. The lectures are there to guide you and assist you in learning the material, but remember whose responsibility it is to actually do the hard work of learning the course material. Showing up to lectures is important, but is not nearly enough to succeed in the course; you must do additional work on your own, and ideally also with your study partner or study group, to really learn the course material well.

8. Pay Attention to Your Life

There is a kind of art to living life, and if we thought of our lives as works of art, imagine how this would change the way we live. All of us are inundated with distractions every day, crafted by experts in addiction to steal the most valuable of our resources: Our time and attention. We all have to figure out how to cope with this insidious problem, but it's particularly dangerous for you young people, because you are in the primes of your lives, with the potential for rapid development. Your brains could indeed develop rapidly and beautifully if you stimulate them effectively, but this is difficult to do because of the intense pressure we all feel from addictive electronic gizmos.

I highly recommend that you put into place some system that helps you to avoid your addictive electronic devices for long periods of time during the day so that you can focus your attention on what truly matters, which is to develop yourself to the highest degree. To help you in this quest, laptops or portable alert devices like smartphones or smartwatches are not allowed during lectures. Turn them off, and put them well away from your consciousness. Research shows that even if your phone is turned off but it is within your view, it poses a significant distratction. Physics is hard enough to learn as it is; there is no reason to try to learn it while you are cognitively impaired.

This may be appear to be inconvenient, but there are important reasons for this. Multitasking is known to reduce the quality of performance in all tasks, and not just for you but also for people around you. Our lecture room is a cramped space, with students seated in close proximity, and even silent visual alerts on a screen affect others.



Taking lecture notes longhand ensures that important cognitive encoding takes place. This is particularly important in a conceptual course such as physics. See here for more details; and a ScienceDirect link to the source of the [Canadian!] data.

The following are the only exceptions to the policy of no electronic devices:

» a registered learning disability that requires the use of a laptop (requires a note from the Student Accessibility Services, delivered to the instructor in person);
» an electronic paper device, laid flat on the desk and used to make hand-written notes electronically, **must be in airplane mode**;
» volunteer firefighters or medical professionals on-call are allowed network-active devices on silent (requires a letter from the employer, delivered to the instructor in-person).

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