Physics 21, Spring Semester 2013

http://www. lehigh. edu/inphy21/

Instruction Personnel

INSTRUCTOR

Prof. Ivan Biaggio, LL 407
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HOMEWORK AND RECITATIONS, TEACHING ASSISTANTS

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Each student's primary contact should be their recitation leader. If you have questions or need more help with an assignment, don't hesitate to ask during recitations, don't delay contacting (email) or visiting your recitation leader. But do try something yourself before going to the TA, otherwise it will be inefficient. Office hours will be set independently.

Required Materials and equipment

TEXTBOOK

Randall D. Knight, "Physics for Scientists and Engineers: A Strategic Approach", 3d Edition, Volumes 3 and 4. Note that volumes 3 and 4 cover chapters 20 to 37 of Knight's book.

CLICKERS

Required for lecture activities (and also useful to earn extra bonus points in the lecture).

COURSE SITE

Homework assignments, solutions, and any other additional material that we provide will be posted there.

Time, location, and organization

LECTURE

Tuesday and Thursday, 09:20-10:10, LL 270.

RECITATIONS

Wednesday and Friday

Classes meet four times a week, Tuesday and Thursday all together for the lecture, Wednesday and Friday in small recitation classes. The lectures will introduce new material and cover the most important principles, and in general highlight the fundamental ideas that must be understood. Recitation sections will discuss some more examples and ideas, and go into more details about problem-solving. Recitations will be a very important playground for exercising and repeating the material, it's not just about the weekly homework.

It is important to realize that this is a fast-paced course which does require **a lot of work**. It is critical that you digest and exercise the material presented during one week before the next week starts. It is also very important to ***read the textbook***, and do it *before class*. Scrupulously follow the reading assignments, and don't be a minimalist. You will do best if you read *more* than what is stated in the reading assignments. Read the textbook, but also read anything else you may find useful. Like the suggestion I have at the bottom of next page.

Reading Assignments

Reading assignments are an integral part of the course. Students are expected to prepare for each class by reading the corresponding chapter(s) in the textbook ***before*** coming to class. With the time I have, it is impossible for me to tell you everything that you need to learn in the lectures alone, but I can guide you by highlighting the most important things. It is important to read the textbook before class because, even if you don't get everything immediately, it will provide you with background information that will help you better understand what will be presented in the lecture. In addition, students will be expected to know the material in the reading assignments even if it is not explicitly discussed in the lecture or the recitation sections!

Course grading

The final grade of the course will be determined by a combination of the points obtained in the two hour tests, the final exam, homework, and quizzes. Here is a grade distribution table:

Exams	400	(100 from mid-term 1, 100 from mid-term 2, and 200 from the final exam)
Homework	100	(accumulated by adding homework points up to a maximum of 100)
Quizzes	100	(obtained from the grades of the best 7 out of 10 quizzes)
Total	**600**	

An ***additional 50 bonus points*** that can contribute to the above total will be given away during the lecture through clicker questions. Make sure you buy a clicker and register it. Instructions are on coursesite.

Some general advice

LECTURE PLAN AND TEXTBOOK

In regards to reading the textbook, a note of advice: do not just read it sequentially. Keep going back and forth and look at sections over and over again. Read the questions at the end of the chapter, and then go back to look for information based on what you can answer and what you can't. Reading sequentially is the worst way to digest the material. In this class I will follow my own path through the material, described in the *PHY21-2013-Plan* (see coursesite). This path is dictated by not having enough time to discuss everything myself. My path has its own logic highlighting relationships that may not be seen just by following the textbook sequentially. Another advantage of doing this is that the reading assignments will also not be just sequential, which will help you access the book in an efficient way, and get a feeling of the different ways each topic or physical effect can be associated together. This will in turn be very helpful for general understanding, and will make you better at solving problems because it trains you in seeing relationships. Do also consider additional reading. As an example, see the suggestion at the end of this page.

WHAT IS THIS REALLY ABOUT?

Many different students take this course. Some of you may be interested in physics. Some of you may have to take this course as a prerequisite and don't see the reason why. Some of you may hate the fact of having to take physics. Some others may love it. Maybe you will encounter some homework problem that seems to be too esoteric or appears totally useless. Or you may find problems that seem too easy or boring. There may be some of you who will only be interested in their grade, or a few who don't care too much about the grade but just want to be done with this course and move on to other things. Some others will be happy to learn something about how the universe works, and others still will seriously love physics.

Because of the diversity of interests in the students taking the course, we need to cover all backgrounds. What I will try to do with this course is help everyone, no matter what their aim is: give something to the physics lovers to go beyond what's in the standard textbooks, provide a structure that allows to get a decent grade even if you are not a physics fan – provided you are willing to do the work. But most of all, the important question is what will remain after the course is over at the end of the semester.

Part of what is developed during this course is the ability to *calculate* and *solve problems*. This is a valuable skill that will be useful whatever you do in the future. Such a skill is built through *practice*. It is the same as in music or in athletics. Practice is what allows you to master something, and developing problem solving skills requires doing many problems, alone. We help you to do this by providing homework assignments and discussing them with you.

Another part of what is developed during this course is the *knowledge* of some things that happen in the universe and an *understanding* of how they work. Or how one can use them to do something new. This kind of understanding and knowledge is achieved only when one acquires the ability to see how the various things we will discuss are related to each other. It is possible to go through a course like this one and only do the equivalent of analyzing clusters of pixels and their color, or how they are arranged. But true understanding is only reached after you are able to take a step back, see the whole picture produced by all pixels together, and learn how different parts relate to each other. It is important to achieve this ability to see the whole picture, while at the same time we work on some details by zooming into it. This is what is very difficult to achieve by just reading a textbook sequentially, and where my role in the lectures comes in. By stressing the ***fundamental qualitative principles*** of the physics we are teaching I will take a spotlight and illuminate the various parts of the picture and guide you through it. Tell you how some physical effects are related to each other, highlight which parts of the textbook are really important, and help you distinguish them from the parts that are just additional descriptions or examples.

The ultimate aim is not just to be able to solve problems in a test. It is to obtain some background knowledge and some work habits and strategies that will be useful for you later on,

ADDITIONAL WAYS TO HELP YOU LEARN

The basic trap many people fall into because of various reasons, including former training and the way people are tested in school, is the big bear trap of thinking that knowing the material is equivalent to solving the standard problems, with the associated belief that in order to solve a problem one needs to find the formula to do so.

This doesn't work. This has never worked. The very first thing you need to do to solve a problem is visualize it, make a sketch of what is going on, or what you think may happen, decide what basic principles can be understanding the issues, set up some basic relationships, *and then, once you have an idea about what to do*, start thinking about equations. Equations, not formulas. Because equations are the mathematical description of a *relationship*. Then, at the end, you will see that you need some formulas, and you will go get them and finish solving the problem.

To develop the way of thinking that I describe in the paragraph above, it is necessary to develop an understanding of how things "work" in general terms, of how different effects are related to each other, or can be described in a similar way, etc. I will try to give an intuitive feeling in the lecture whenever I can, but you should also look for other sources beyond our classes or the textbook. You can find lots of things just on the web. Here I just want to suggest a little, cheap booklet that you can read on the side – like a series of good newspaper articles – and that should help you develoop a good alternative explanation of the concepts we teach. You can get *"Understanding Physics: Volume 2: Light, Magnetism and Electricity" by Isaac Asimov* for $4 (check the usual on-line bookshops). Get it, read it. I am sure it will help.

Homework assignments and quizzes

HOMEWORK

A new homework assignment will be uploaded on coursesite every week. But please be aware that this weekly homework is in practice ***two*** assignments that are distributed at the same time and you start working on them immediately. Most courses like PHY 21 distribute two homework assignments per week, with 3-4 days to finish and hand in each one. But my opinion is that the interested students can profit much more from the homework assignments if they have some time to pace their work, with more time to discuss individual problems with their recitation leader if needed. Because of this I prefer to distribute all the assignments for one week at the same time. But again, be aware that this is a double-edged sword. If you try to minimize what you do on the homework and procrastinate, then you will have too much to do at the same time, which means that you will not be able to use the homework to develop your understanding of the topic, and that you will end up with an incomplete work to hand in.

With each weekly homework you can earn up to **12 points**, and there will be **12 homework assignments**. Homework points can be collected up to the maximum of **100 homework points** that count for the final grade. Note that we are providing 44 points more than what is needed to maximize the homework contribution to the final grade. Thus, it won't be an issue if you miss out on one homework because you are sick for a week or because of any other problems.

New homework assignments will be posted on coursesite on Tuesday afternoon. You must hand in each homework assignment in **two stages**. On Friday, you must hand in a **short narrative** describing the steps you intend to take towards solving each of the problems, but without any calculations. Then, next Wednesday, you must hand-in your **final solution**, as complete as possible. Both steps will be graded. Both will count towards the total amount of points that you can earn with each weekly homework assignment. Late homework will not be accepted

Homework solutions will be posted Wednesday evening (the day you hand in your final work) on coursesite, and you must read the solutions and compare them to what you did. We provide full, detailed solutions, so it is not the responsibility of the grader to go through and find your mistakes for you. Going through the solutions we post and comparing to what you did is a avery important exercise that will help you a lot!

Your homework will be returned to you by the next Wednesday, when you hand in your next homework.

QUIZZES

There will be one short quiz every week during Friday's recitation. Of all the quizzes, only the best 70% will count for the final grade. We plan to do 10 quizzes and only the 7 best ones will count towards the 100 Quiz points that contribute to the final grade (see above). No make-up quizzes will be given.

A TYPICAL WEEK

day 1	Tuesday	**HW n** posted		
day 2	Wednesday	hand in completed **HW n–1**	**HW n–2** back to you	Solutions **HW n–1** posted
day 4	Friday	hand in **HW n** narrative	Quiz	
day 9	Wednesday	hand in completed **HW n**	**HW n–1** back to you	Solutions **HW n** posted

A note on academic integrity, etc.

Some nice discussions among friends is always a good way to learn and exercise the material, but do try to work on the assignments alone. Always relying on help from others will work against you because it doesn't allow you to identify the areas where you have more difficulties (unless you are the one the rest of the group is copying from). Teamwork on tests is cheating. Doing homework as a team or copying homework is also against academic integrity: please see the links in the top-left corner when you enter coursesite. But most importantly, copying your homework is a guaranteed way to not learn the material and to get a bad grade in the end. So just don't do it.

A similar effect applies to tutoring. Ask a tutor if you need help, but try doing the problems alone first!! Getting into the habit of obtaining hints and help on a homework assignment before trying to do it yourselves is the absolute worst thing you can do. The most difficult part of solving a problem is finding the right path to work through it. That's what you need to exercise.

In order to help you in exercising exactly this aspect of problem-solving, in our course you will be required to hand in a **narrative** for each homework where you lay out the steps that you plan to take to later solve each problem. This will be a "no math" statement of a few sentences. But coming up with the statement yourself is the key. Going to a tutoring class where they tell you what to do and leave only the math for you defeats the purpose of doing homework and will work against you in the tests and in anything else.

Exams

MID-TERMS

There will be two hour tests that will take place according to the plan issued by the Registrar's office. The grade of the hour tests will contribute to the final grade only if it ***improves*** on the grade of the final exam. No make-up tests will be given.

FINAL

There will be one comprehensive final exam. The date and time of the final exam will be set by the Registrar.

Grades of all tests and exams will be merged into one total *exam grade*, which will contribute to the final grade as described by the grade distribution given earlier. This exam grade is either the final exam grade or the result of the weighted average

$$(m1 + m2 + 2\, f)/4,$$

whichever is larger (in the formula, $m1$, $m2$, and f are the numeric grades – ranging between 0 and 4 – of the mid-term tests and of the final exam, respectively). This is equivalent to each midterm contributing 100 points, and the final contributing 200 points. But the mid-term exams will contribute to the final exam grade only if they *improve* it. This means that you can do badly in the hour tests and not suffer any consequences provided that you do well in the final exam. On the other hand, a good hour test performance will allow you to build a floor for the total exam grade.

Exams are closed book, but a summary sheet with the most important facts and expressions will be provided. You don't need to memorize any formula.

Accommodations for Students with Disabilities

If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of Academic Support Services, University Center C212 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.

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Spring Semester 2013

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Time Plan

Wk	Date	Day	reading assignment	Topic	HW & Quizzes
1	1/15	Tu	25.1-25.4	Electric charge. Conductors and Insulators. Point charges. Coulomb law.	
		W		Vectors, Sum of Coulomb forces.	HW1
		Th	25.3,25.5, 26.1-26.3 26.5	Electric Field and Force. Examples of electric fields. Parallel plates. Energy density of electric field.	
		F	26.3-26.4	Integrals (to find field), Dipole	
2	1/22	Tu	27.1-27.6 (see also 29.4)	Electric Flux, Gauss, Conductors, Field at surface of conductor.	
		W	27.5	Applications of Gauss	HW1/HW2
		Th	28.1- 28.6	Electrostatic potential, from charges and electric field.	
		F	28.7	Potential from point charges and from charge distribution.	Quiz 1
3	1/29	Tu	29.1-29.4	Gradient of Potential. Field at surface of conductor. Repeat energy density of field.	
		W		Review of Electrostatics	HW2/HW3
		Th	30.1-30.4 32.3	Moving charges in wires. Current and conduction. Ohm's law. Magnetic field of moving charge.	
		F	28.2	B-field of moving charge, current-element	Quiz 2
4	2/5	Tu	32.2, 32.4 - 32.6	Magnetic fields from moving charges. Field lines, Ampère Law.	
		W	27.5	Reminder of vector product.	HW3/HW4
		Th	32.7-32.9	Magnetic force on moving charge, and on current element. Magnetic force on current carrying wires. Magnetic Torque on loops.	
		F	32.9	Lorentz force. Force between wires, example of devices (motor).	Quiz 3

Wk	Date	Day	reading assignment	Topic	HW & Quizzes
5	2/12	Tu	33.1-33.6	Induced current. Magnetic flux, Faraday Law, Electromotive force (emf). Lenz. Eddy currents.	
		W		Repeat induction. Eddy currents.	HW4/HW5
		Th	33.5, 33.6. 33.7, 34.2, 34.3	General form of Ampére Law. Displacement current.	
		F		Examples, Eddy currents in superconductors.	Quiz 4
6	2/19	Tu		Review, Electricity and Magnetism	
		W		Examples, review	HW5/HW6 MID-TERM
		Th	34.4, 34.5, 34.6	Maxwell's equations. Electromagnetic waves.	
		F		Light: E and B fields.	_
7	2/26	Tu	34.5, 36.2, 34.1, 34.2	Electro-magnetic waves. Speed of Light. Electrodynamics in different reference frames	
		W		Light: Energy density, Intensity.	HW6/HW7
		Th	34.1, 36.3, 36.8	The need for the theory of special relativity.	
		F	34.6	Poynting vector and momentum	Quiz 5
8	3/5	Tu	29.5-29.7, 32.10	Electric Polarization. Dielectrics. Magnetization. Magnetic materials.	
		W	29.7	Gauss law in dielectrics	HW7/HW8
		Th	30.4,30.5, 31.1-31.4	Capacitors, Electric current, Resistivity and resistance. Introduction to circuits.	
		F	29.5, 30.5	Repeat resistors and capacitors.	Quiz 6
	3/12	SPRING BREAK			
9	3/19	Tu	31.2, 31.6-31.9	Kirchhoff rules, RC Circuits, power, and energy in capacitors	
		W	31.5	Batteries, internal resistance	HW8/HW9
		Th	33.8-33.10	Inductance, LC and LRC circuits, Energy density of magnetic field	
		F	33.7	Mutual inductance, Transformers	Quiz 7

Wk	Date	Day	reading assignment	Topic	HW & Quizzes
10	3/26	Tu	35.1-35.3	AC Circuits	
		W	33.7	Inductance, transformers	HW9/HW10
		Th	35.4-35.6	AC Circuits, power	
		F		detecting e-m waves: radio.	Quiz 8
11	4/2	Tu		Review of electrodynamics and circuits	
		W		Review.	HW10/HW11 MID-TERM
		Th	20.1-20.5, 22.1 21.1, 21.2, 34.7	Electromagnetic waves. Light. Refractive Index. Light Polarization. Wave optics	
		F	34.7	Light waves, polarization.	–
12	4/9	Tu	21.5-21.7 22.2-22.4	Superposition, Interference. Two slit interference pattern, single slit diffraction.	
		W		Coherent superposition vs. incoherent light	HW11/HW12
		Th	22.3, 22.5-22.6 23.1-23.3	Diffraction grating, interferometers. Reflection and refraction, lenses.	
		F		Examples of diffraction patterns, gratings.	Quiz 9
13	4/16	Tu	23.1-23.6	Ray Optics, lenses	
		W	23.3	Examples of refraction, total internal reflection.	HW12/HW13
		Th	23.6-23.8, 24.1, 24.2	Ray Optics, Mirrors and Lenses. Imaging.	
		F	23.5	Color.	Quiz 10
14	4/23	Tu	24.1-24.5	Imaging, Resolving power. Two slit interference with electrons.	
		W	24.4	Imaging examples. Microscopes, telescopes.	HW13
		Th		Summary. Where to go from here? Electro-dynamics, relativity, and quantum physics.	
		F		Review	