

Syllabus Physics 21, Fall Semester 2016<http://www.lehigh.edu/inphy21/>**LECTURE**Tuesday and Thursday, 09:20-10:10 *and* 10:45-11:35, LL 270.**RECITATIONS**

Wednesday and Friday, various times

Instruction Personnel**INSTRUCTOR**Prof. Ivan Biaggio, LL 407
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Student's primary contact should be their recitation leader, a.k.a their teaching assistant (TA). 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 equipmentFurther details and instructions on how to sign up for all of the services below are at <http://www.lehigh.edu/inphy21/>.**TEXTBOOK**

Randall D. Knight, "Physics for Scientists and Engineers: A Strategic Approach", 3d Edition, Volumes 3 and 4. Volumes 3 and 4 cover chapters 20 to 37 of Knight's book. We will cover the same material, but not in the same sequence.

CLICKERS

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

MASTERING PHYSICS

Weekly homework assignments.

COURSESITE

Any other class material is made available there.

Initial Competences Required for this course (what you should know already)

Before starting this course, students should already be able to describe and predict, quantitatively, the movement of bodies in terms of the forces acting on them (basically the contents of physics 11). Knowledge of vectors and how to use them is also necessary, together with the ability to write and solve algebraic equations, familiarity with the meaning of derivatives and integrals, and ability to write and use integrals. Knowledge of the simplest differential equations and their solutions will also be an asset.

Course contents (what we will teach in this course)

We will introduce students to electric and magnetic fields, their origins, and their effects. We will explain how those fields are generated, and what they do to electric charges, electric currents, and to each other. We will also explain the origin of electro-magnetic waves, how they relate to light, and explain how light propagates through systems consisting of lenses and mirrors and how images are formed. We will also discuss the quantitative analysis of electric circuits, that is the systems that are obtained when one wires together such elements as "resistors", "capacitors", and "inductors" and sends an electric current through them.

Competences expected after this course (what you will be able to do when done)

After this course, students should be able to analyze both conceptually and quantitatively simple situations involving charges, currents, electric fields, magnetic fields, resistors, capacitors, inductors, electro-magnetic waves, light waves, and the phenomena of electromagnetic induction, diffraction, and interference. This means that students will be able to derive algebraic expressions that allow to calculate the value of physical quantities as they are determined by other physical quantities in specific situations. For example, students will be able to calculate, algebraically and numerically, the magnitude and direction of a magnetic field at a certain point in space when given the values and the coordinates of specific current distributions, or the rate of change of an electric field. As another example, students will be able to design a system that uses lenses or mirrors to form the image of an object at a specific location, and they should also be able to determine the light intensity pattern on a screen as it is affected by diffraction or interference. As regards electric circuits, students should be able to quantitatively determine the currents and voltages that will appear over various circuit elements as voltages are applied, or currents are forced through the circuits, or switches are flipped. Finally, students will also be expected to be able to calculate the speed of light, and explain its origins and its characteristics.

Time, location, and organization

It is important to realize that this is a fast-paced course which does require *a lot of work*. The rule of thumb when you take a course, is that for every credit hour you need to work *three* credit hours on your own. This course is a 4 credit hour course, and therefore it is totally normal and expected that you work 12 hours a week in order to learn all the required material and in general keep up with the coursework. It is critical that you digest and exercise the material presented during one week before the next week starts.

The material that you will learn in this course will come from multiple sources (lectures, recitations, textbook, on-line homework, paper homework, reading-assignments). Lectures introduce new concepts and serve as a guide to the connections between the different topics. They also highlight the most important ideas and techniques. Homework assignments solidify what has been introduced in lectures by allowing the students to apply the concepts and technique they just learned. Recitations are where students get a chance to ask lots of questions, and where homework problems are discussed and problem-solving exercised.

Do not just read the textbook, do not just come to class: this course is **designed** for you to learn the material through a combination of reading, attending classes, going to recitations, and the practice in problem-solving that you get by doing both the on-line homework and the weekly “learning homework”. The lecture and the other activities are **integrated**. I designed how the material that you will learn is transmitted to you via lecture, reading assignments, on-line homework, paper homework, the corresponding solutions, and the examples discussed in the recitations. I do the lecture, but I also pick the homework, do the solutions, and I designed the path we follow when teaching the material. Therefore, to profit from this course you must do everything. Sometimes it is useful to introduce a new concept in a homework, often it is done in the lecture. Sometimes there is a deeper explanation of a particular technique in the solutions to the “learning homework”. Sometimes we calculate through an example in the lecture, but often you work through examples in recitations, and the lecture must use its limited time for explaining and connecting concepts for all of you.

Classes meet four times a week, Tuesday and Thursday all together for the lecture, Wednesday and Friday in small recitation classes. To accommodate everyone, the lecture is held twice (!), once starting at 9:20am, the other starting at 10:45am.

Reading Assignments and how to use them

Reading assignments are provided in the class plan posted on coursesite, which details the material that will be discussed in every lecture, and the corresponding sections in the textbook. Reading assignments are an integral part of the course. You can go through the reading assignments both before and after the material is handled in the lecture. But everything will be easier if you prepare for each class by looking at the corresponding section(s) in the textbook *before* coming to class. It’s important that you do so even if you don’t understand everything at first, and even if you just skim through the material, because this will help you acquaint yourself with names and definitions, and you will then be able to follow the lecture much better. After the corresponding lecture, you can then go back and re-read the relevant sections in the textbook. Nobody understands something by just hearing or reading it once.

In general, it is very important to read the textbook, or any other material you might find, on-line or otherwise. Reading different explanations by different people is the best way to learn and understand a topic.

At the end of the course, students will be expected to know the material that is exercised in the homework and that is presented in the corresponding chapters of the textbook even if it is not explicitly discussed in the lecture or the recitation sections! It is worth stressing that with the time I have in the lecture, it is impossible for me alone to tell you everything that you need to learn, but I can guide you by highlighting the most important things. I will also provide written weekly summaries of what I do in class.

In summary, 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 popular science or history of science in the 19th century (see suggestion at the very end of this text).

Course grading

The final grade of the course will be determined from the total number of “points” collected by the students. These points are obtained in the two hour tests, the final exam, homework, and quizzes as follows:

Exams	300	(75 from mid-term 1, 75 from mid-term 2, and 150 from the final exam)
Homework	150	(accumulated by adding homework points up to a maximum of 150)
Quizzes	75	(obtained from the grades of the best 7 quizzes)

Total **525**

Additional extra-credit points that can also contribute to the above total will be given away during the lecture through clicker questions. You get extra-credit points for every question answered, it doesn’t matter if you answered correctly or not. The maximum number of extra-credit points collected in this way is 50.

Homework assignments and quizzes

ON-LINE HOMEWORK

A new homework assignment will be made available on masteringphysics by each Tuesday (**MPa**) and each Thursday (**MPb**). Every MP homework counts 8 points, for a total of 16 points each week.

Assignments will appear on masteringphysics at least one day before recitations take place. Thus, every homework assignment can start to be discussed in recitation the following day: you must have a look at it before you go to recitation! **MPa** (the Tuesday homework) must be submitted on-line two days later by Thursday at midnight, so that its solution can be discussed on Friday. **MPb** (the Thursday homework) must be submitted on-line five days later by Tuesday at midnight, the following week, and its solution can be discussed in recitation the day after. The submission deadline is strict. The system does not allow for late submissions and late submissions won't be accepted.

LEARNING HOMEWORK

The "learning homework assignment" (**LHW**) will be posted on coursesite at the beginning of every week. It consists of a single problem that aims at discussing and teaching some aspects of the material in a different way than what can be done with the on-line homework. You must hand in each learning homework assignment in two stages. On the first Friday after the assignment appears, you must hand in a short narrative in English (no math) describing the steps you intend to take towards solving the problem, but without any calculations. Then, you must hand-in your final solution, as complete as possible, one week later, on the next Friday. Both steps will be graded on a scale from 0 to 2, delivering 4 extra homework points per week that will count towards the total homework points mentioned above. Late homework will not be accepted. The purpose of the learning homework is to stimulate critical and creative thinking and to provide a different way to learn a topic. The aim is not even necessarily to complete it in full, it is discuss its contents and then work with the solutions to understand what is going on.

Solutions to the learning homework will be posted Friday evening (the day you hand in your final work) on coursesite. You must read the solutions and compare them to what you did. I will 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 yourself and comparing to what you did is a very important and helpful way to learn the material.

HOMEWORK POINTS THAT COUNT TOWARDS YOUR GRADE

Homework points can be collected towards the *150 homework points* that count for the final grade. Do the math: two MP assignments each week at 8 points each give 16 MP points per week. Over 12 weeks this already gives 192 points, 42 points more than what you need to maximize the homework contribution to the final grade using masteringphysics alone. And in addition, the LHW provides up to 4 points per week, that is up to 48 points over 12 weeks. So you can collect up to 240 points per week thanks to both MP and LHW homework, but you only need 150. This means that it won't be an issue if you miss out on one homework because you are sick or because of any other problems. Note that the LHW counts towards only 4 of the 20 weekly homework points you can collect. You should do it because it is more challenging, promotes understanding and discussion, and will help you in the long run. So it is not a big deal if you don't solve it all, but you must try to do as much as you can, and there will be solutions to discuss!

QUIZZES

There will be one short quiz every week during Friday's recitation. Of all the quizzes, only the best 7 will count towards the 75 Quiz points that contribute to the final grade. There won't be any make-up quizzes.

HOMEWORK ORGANIZATION FOR A TYPICAL WEEK

w i, day 1	Tuesday	Submit MP_b_{i-1}	MP_a_i available	LHW_i available
w i, day 2	Wednesday	Discuss LHW_{i-1} , LHW_i , and MP_a_i		
w i, day 3	Thursday	Submit MP_a_i	MP_b_i available	
w i, day 4	Friday	Hand in LHW_i narrative	Hand in LHW_{i-1}	Discuss LHW_i and MP_b_i

The most important thing you need to know

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 (the *narrative* that is part of the weekly learning homework is meant to help with this)

In addition to the academic integrity issues, copying your homework is a guaranteed way to not learn the material and to get a bad final grade. A similar effect applies to tutoring. Ask a tutor if you need help in understanding what the homework is about, but try doing the problems alone first!! Going to a tutoring class where they tell you what to do, or getting hints for solving a problem that let you skip the step of actually finding the way towards a solution will leave you with only the math to complete. This is bad because then you don't train problem-solving. Working like this defeats the purpose of doing homework and will work against you in the tests and in anything else.

Exams

Exams are closed book, but a summary sheet with the most important facts and expressions will be provided, and you can add some small notes for yourself on it. You don't need to memorize any formula.

MID-TERM HOUR TESTS

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 EXAM

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

EXAM GRADE

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 between the mid-term grades m_1 and m_2 and the final grade f , with the final carrying twice the weight of a midterm. As an example, the final grade will be calculated via

$$(m_1 + m_2 + 2f)/4$$

if the result is larger than the final grade f . But if one of the mid-terms was so bad that it would work against you, then the total exam grade will be calculated via $(m_i + 2f)/3$, where m_i is the grade of the other midterm. Or if the grade in the final exam is better than both mid-term exams, then your final exam grade will be just f , the grade of the final exam. 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.

Beware that this rule should not mean that you don't prepare for the mid-terms. Doing well on the mid-term will alleviate a lot of anxiety because the grade you get helps with the final grade. Also, what you study for the mid-terms is something you won't need to work with as much for the final!

Some final 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 an optimized path through the material, described in the plan made available on coursesite. This path has been designed to highlight the relationships that may not be seen just by following the textbook sequentially. A counterintuitive advantage that follows from this is also that the reading assignments will not be necessarily 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. But in addition to the textbook, do also consider any other source material that you can find, from wikipedia to anything else that you might find useful (see the last section below).

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. Others may love it. Maybe you will encounter some problems (especially as part of the learning homework) that seems to be too esoteric or appear to be totally useless to you. 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, while not bothering the other students too much. Provide a structure that allows to get a decent grade even if you are not a physics fan – if 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. There is no other way. 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. Imagine that what we will learn is represented by some big photograph. 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.

PROBLEM SOLVING

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*. Use algebra for as long as you can. At the end you will get a formula that represents our solution, an algebraic expression. Only plug-in numbers at the end.

ADDITIONAL WAYS TO HELP YOU LEARN

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 develop a good alternative explanation of the concepts we teach. For example, 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.

A note on academic integrity, etc.

[Academic integrity](#) applies to all we do. Teamwork on tests is cheating. Doing homework as a team and especially copying the solutions of homework assignments are also against academic integrity; please see the links in the top-left corner when you enter coursesite. In any case, some nice discussions among friends are 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 will not allow you to identify the areas where you have more difficulties.

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, Williams Hall, Suite 301 (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.

The Principles of Our Equitable Community

Lehigh University endorses The Principles of Our Equitable Community. We expect each member of this class to acknowledge and practice these Principles. Respect for each other and for differing viewpoints is a vital component of the learning environment inside and outside the classroom.

http://www.lehigh.edu/~inprv/initiatives/PrinciplesEquity_Sheet_v2_032212.pdf