

Syllabus Physics 21, Fall Semester 2024<https://lehigh.edu/inphy21/>**Lecture**

Tuesday and Thursday, 10:45-11:35, LL 270.

Classes meet four times a week for lectures and recitations. Lecture times are at 10:45am in LL270. Check the time For your recitation section. All students attend the lectures together, on Tuesdays and Thursdays, They then meet in small groups on Wednesdays and Fridays.

Instructor

Prof. Ivan Biaggio, LL 407

phy21@lehigh.edu

Office Hours: After each lecture, Mo and Wed from 4:25pm to 5:30pm.

Recitations

Wednesday and Friday, various times

Recitation Leaders / Teaching Assistants

Ian Ali laa219@lehigh.edu 1:35-2:25 PM, LL309	Jace Curran ggc220@lehigh.edu 1:35-2:25 PM, LL310	Seyed Hosseini seh722@lehigh.edu 7:55-8:45 AM, LL309	Jean Toulouse jt02@lehigh.edu 10:45-11:35 AM, LL309 12:10-1:00 PM, LL309	Simin Xia six220@lehigh.edu 9:20-10:10 AM, LL309 3:00-3:50 PM, LL309
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You'll see your recitations leaders, a.k.a your teaching assistant (TA), twice a week in small groups, and they are your primary contact. If you have questions or need more help with an assignment, ask during recitations, or get a meeting with your TA. Office hours will be set independently. Your professor's office hours are given above.

How to get help: Use the homework assignments to determine the areas where you have difficulties or are in doubt, make a list of what you don't "get", and then come to office hours or tutoring meetings. Do not just ask something like "can you give me some hints about this problem?" Determine first more precisely where you have problems when trying to solve the problem, and then ask specific questions.

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

How to describe and predict the movement of bodies in terms of the forces acting on them. Vectors and how to use them. Writing down algebraic equations and solving them. Familiarity with derivatives and integrals, and knowing what they mean and how to use them. Knowledge of what differential equations are and how to solve the simplest ones.

Course contents (what we will teach in this course)

Electric and magnetic fields, their origins, and their effects: how those fields arise, and what they do to electric charges, electric currents, and to each other. The origin of electro-magnetic waves, how they relate to light, how light propagates through systems consisting of lenses and mirrors, and how images are formed. How electric circuits work: what happens when one uses conducting wires to connect together elements as "resistors", "capacitors", and "inductors" in various configurations, and then sends an electric current through them.

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

After this course, students are expected to know what happens when charges create magnetic or electric fields, or when they interact with those fields. And to know how electric and magnetic fields create each other, and give rise to electromagnetic waves and light. Students will be expected to be able to look at an electric circuit and describe its components and their main effects, and to know what the speed of light is, how light propagates in different transparent materials, and the meaning of interference, diffraction, and other optical phenomena like total internal reflection. Finally, students will be expected to know what a diffraction grating is, how mirrors and lenses work, and how lenses and mirrors are used in optical imaging systems.

In addition to *knowing* all those things mentioned in the above paragraph, students will also be expected to be able to *use the mathematical tools of physics* to quantitatively determine what happens in all those scenarios, calculating and predicting such things as the strength and direction of an electric or magnetic field, the magnitude of currents induced by changing magnetic fields, the currents through the various elements in an electric circuit, the intensity of light and the appearance of its interference or diffraction patterns, and the location and size of images in optical systems. "Calculating" here means to derive algebraic expressions that describe a quantity and how it depends on other things, followed by also using numbers to arrive at a numerical result.

For example, students will be expected to be able to calculate, algebraically and numerically, the magnitude and direction of a magnetic field at a certain point in space when given a certain current distributions, or the time dependence of an electric field. As another example, students should be able to design a system that uses lenses or mirrors to form the image of an object, and to determine the light intensity pattern on a screen as it is affected by diffraction or interference. Students will be able to quantitatively determine the currents and voltages that will appear over various circuit elements as voltages are applied, currents are forced through the circuits, or switches are flipped.

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Challenges and motivation

The following paragraph is from the editor's blurb about a physics book (found [here](#)). I believe this description addresses an important truth and an important difficulty. I am pasting it here without any changes:

In typical physics classrooms, students seek to master an enormous toolbox of mathematical methods, which are necessary to do the precise calculations used in physics. Consequently, students often develop the unfortunate impression that physics consists of well-defined problems that can be solved with tightly reasoned and logical steps. Idealized textbook exercises and homework problems reinforce this erroneous impression. As a result, even the best students can find themselves completely unprepared for the challenges of doing actual research.

(I would also add that this also applies to engineering and other fields, not just physics)

This is an introductory physics class, so we cannot avoid going through the details and teaching the toolbox, or doing the standard homework assignments (via *masteringphysics*). They are necessary to practice the ability to do the calculations, which is an important skill. But what is also necessary is to first know what certain words mean, and in general “what happens” in various situations. To efficiently use the mathematical toolbox, you must also understand things in terms of simple descriptions of cause and effect, without any math. And you must learn how the descriptions are related to certain symbols and mathematical equations. This is what the paragraph above is worrying about, and this is what will give you the flexibility to actually use the skills that you learn here in future, seemingly unrelated settings.

The important skills are then: Understanding what could be happening qualitatively in the situation described by any problem, doing this by translating what a problem is saying in drawings or other schemes. This leads to developing a path to a solution, which must be done before doing any calculations; often there could even be guesses of how a solution should look like, which then can be used to evaluate the correctness of calculated results. The problem is that these skills cannot be taught (or learned) directly, but need to be developed through practice. Here what you should do:

- Print out the mastering physics assignments, do the work on paper (keep those papers in folder or notebook so that you can go back to them), and only at the end copy the results into the masteringphysics forms online.
- You don't need to do every single assignment you find on masteringphysics every week, but look at all of them and do enough of them to collect your homework points (come back to do more problems later, while reviewing and studying).
- Do not copy the solutions to homework assignments. You won't develop the skills you need if you do this.
- Do the Learning Homework (LHW) Assignments. **Always do at least the Narrative part.** Write questions for you TA on the paper that you hand in with your solutions. You generally don't need to solve the LHWs completely, but attempting to do as much as you can and making a list of your difficulties is important. That's what LHWs are for.
- Look at assignment early, and start by noting anything you don't understand in how the problem is described. Then write a set of questions that you can ask in recitation.
- Do not read only my class summaries, or only the textbook, any other additional reading about the same topic can be useful.
- Suggestions on study techniques, deliberate practice, etc., are found later in this syllabus, and on coursesite.

“Do as much as you can” Exams

This may surprise you, but the exams that we do in this class do not need to be solved to a 95% level or above for you to demonstrate mastery of the subject. The exams are designed to test **how much you can do correctly**, they are not designed to test if you can do *everything* correctly.

Therefore, don't be surprised if you will learn that people got an “A” in a test by answering only maybe 60% of the answers correctly. This is not because the exams are “too difficult” or because we grade on a curve. This is because the exams are designed to offer many ways for you to show that you learned the material within the time-constraints of an exam: there is no expectation for anyone to actually do everything (but still, do look at all the questions when you do an exam. You want to exploit every opportunity to show what you can do).

Lecture, Recitations, Homework

The class plan (on coursesite) will tell you more or less what topics we go through every week. The plan also points at the relevant sections in the textbook (both the current one and an older 3d edition). Prepare before class by having a look at the textbook, so that you get to preview the words that will be used in class. Come to class to see what the most important points are and how they fit with the rest. Go to recitation to exercise with lots of examples. Do the homework because the first step towards *understanding* is to try and solve a problem. Even if you can't do it immediately, it is the act of working on a homework assignment will be a decisive step to help you learn the material.

Bottom line

This course is taken by many students with different backgrounds and interests (see page 6). Therefore the course provides a way for students who are not too interested (yet?) to do some work and get the grade that they need, but it also provides ways for more advanced or interested students to challenge themselves, sometimes via the LHW mechanism. Continue reading on the next pages for more details, and remember to contact your TA or your Professor if you have any doubts or any questions.

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REQUIRED MATERIALS AND CLASS ACTIVITIES

Course website

A quick access point to all you need is at lehigh.edu/inphy21, with a summary of how this course will work, instructions on how to sign up for *masteringphysics*, and a link to this syllabus.

CourseSite

Class material is available there.

Textbook

Randall D. Knight, "Physics for Scientists and Engineers: A Strategic Approach",.

Note that the current edition is the 5th edition. I am also providing pointers to the 3d edition, in case you want to get pre-owned printed books for cheap (less than \$20 via amazon or eBay, etc). In addition to this textbook, there are also plenty of free resources online, see for example <https://openstax.org/books/university-physics-volume-2/pages/5-introduction>, or https://www.feynmanlectures.caltech.edu/II_01.html.

Mastering physics

This course will use *masteringphysics* for homework, and you must specify the above textbook (5th edition) when signing up. Assignments must be submitted twice a week, on Tuesday night and Thursday night. For instructions on how to sign up, go to lehigh.edu/inphy21/. They may also offer you access to the electronic version of the textbook.

Class Plan

On coursesite: It lists when each activity takes place, when each topic is taught, and where it is found in the textbook(s).

Lecture summaries

On coursesite: I'll be posting typeset summaries of each week of lectures. You **must** read them. Print them out and mark any sections that you don't understand, to serve as reminders to read more about them, ask questions, and so on. There are wide margins to allow you to add plenty of notes and comments..

Homework

Two weekly assignments consisting of many problems, on line. One weekly assignment (mostly just one problem) on paper. See below.

Full, detailed solutions of each learning homework (LHW)

On coursesite: These are *teaching solutions*, going into details of the particular problem, with additional information and explanations. You should always look at them, even if you happen to not have done the corresponding homework.

Quizzes

Every week in the Friday recitation. These are short questions on topics that have just been taught or discussed during class or past homework. These quizzes serve to check your progress and will be further discussed in recitation.

READING MATERIAL

There are several resources that you can use to help you along. The class plan posted on coursesite details what will be discussed in every lecture, and the corresponding sections in the textbook. You will also have the "lecture summaries" mentioned above. In addition, I will provide a full, detailed solution of the Learning Homework, and if there is enough request for them, I can also write some notes about the solutions to *masteringphysics* problems. Sometimes solutions will go beyond what was asked in the original problems, providing more explanations on related topics.

You must make sure you read the textbook, the weekly-summaries, and the homework solutions. Reading assignments are an integral part of the course

HOMework ASSIGNMENTS AND QUIZZES

On-line Homework (MP)

Masteringphysics will allow you to practice and review the material as it is being taught, and it is the system that lets you collect the largest amount of points towards the final grade. A new homework assignment will be made available on *masteringphysics* by each Tuesday (**MPa**, due Thursday night) and each Thursday (**MPb**, due Tuesday night the next week). Every MP homework counts on average more than 8 points, for a total of at least 16 points each week. You don't need to answer every single questions to get the maximum amount of HW points.

Have a look at each assignment the day *before* recitation, so that you can ask questions if you don't understand a problem. **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 will 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 (LHW)

A learning homework assignment will be posted on coursesite at the beginning of every week. These are homework assignments that are meant to stimulate critical and creative thinking and to provide an additional way to learn a subject, thanks to following a pattern of "think-try-work-ask-understand". Don't do the LHW because of the homework points

you can collect. Do it for the training and understanding that you receive from it, and always study the solutions (see below). The aim of the LHW is not necessarily to obtain a full solution. The aim is to try to solve the problem, but get stuck somewhere, maybe fail to fully solve it, but then use the experience to generate more questions and more understanding. The LHW provides an alternative to the shorter masteringphysics problems that often give the impression that there is just a recipe that one must know. Such recipes do not exist for real problems! The learning experience in the LHW is to *attempt* to solve the problems, and see how far you can go, and then come back to them later.

LHW assignments will require to hand in solutions in **two steps**:

- (1) A short narrative in English describing (a) what you see as the physical principles that are at play in the problem, and (b) the steps you intend to take towards solving the problem, but without any calculations. Both parts, (a) and (b), are required.
- (2) A final solution, handed in a week later, with all your algebraic calculations and results.

This system is designed to develop problem-solving skills and stimulate discussions and questions. The most difficult thing about physics is integrating what one learns about “what happens” and the math that can be used to describe it, which then allows to analyze a physical situation and develop a plan for solving a problem. The *narrative* makes explicit a key problem solving step that is often neglected but is also often the largest hurdle when starting to learn physics.

For each LHW, think first about what it is asking, what are the physical effects that come into play, and put together all ideas that you think might be useful for developing a solution. This is what you do to generate the *narrative*. Start working on a solution only after you have done that.

The short narrative must be handed in recitation on the very next Friday. This gives you a few days to think about it and ask questions. You will get your narrative back on the following Wednesday. But in the meantime you can keep working and start developing the solution. The TAs can also discuss your narrative in personal meetings during their office hours.

The final solution, must be handed in recitation on the Friday of the following week (one week after you handed in the narrative). Once the semester is on its way, you will regularly hand in, each Friday, both the narrative for the new LHW, and the solution for the LHW from the previous week.

Use the fact of giving your recitation leader handwritten paper to also add any written questions you might have!

The narrative and final solution will be graded on a scale from 0 to 4 points, delivering 8 extra homework points per week that will count towards the total homework points mentioned above. Late homework will not be accepted.

Detailed solutions of each LHW will be on coursesite at the beginning of every week. LHW solutions often go beyond what was asked. Read the solutions and compare them to what you did! It is not the responsibility of the grader to go through and find all your mistakes for you. Going through the solutions yourself and comparing to what you did is obviously an important and helpful way to learn the material.

If you find somewhere somehow a solution of any homework assignment, **do not use it**. Using it robs you of the opportunity to learn what you know and don't know, and to practice essential skills. The fact is that *we learn by struggling to do something*. You need to struggle to solve a problem in order to get better at it. Do not look at any solution before you try to do this. Also, do not waste your TA time by submitting something that is not your work. If you are worried about homework points towards the final grade, don't. There are enough points in masteringphysics to max that out.

Note also that the homework assignments and their solutions are useful also in case you choose to not submit your work. Just go through the solutions and try to understand them. It is better than nothing and can help you study: Look up everything you need until you understand a problem and its solution. Then hide the solution somewhere, take a new sheet of paper, and try solving the problem based on what you remember.

Quizzes

There will be one short quiz every week during Friday's recitation. Of all the quizzes, only the best 70% will count towards the 75 Quiz points that contribute to the final grade. There won't be any make-up quizzes.

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 $_{i-1}$	Quiz. Discuss LHW $_i$ and MP b_i

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“DO-AS-MUCH-AS-YOU-CAN” EXAMS

Exams are closed book, but an equation sheet will be provided for you to print out, and you can add some short notes for yourself on it. You don't need to memorize any complicated formula.

Mid-Term Hour Tests

There will be two hour-tests that should take place according to the plan issued by the Registrar's office. There won't be any make-up tests. If you miss a test because of an accident or illness documented with the office of the Dean of Students, you will be able to substitute the grade for the Hour Test you missed with the partial grade obtained in the corresponding section of the final exam.

Final Exam

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

All exams will ask sets of short questions that all have the same weight. Answer as many as you can, pick and choose and do the easy one first, come back later for the harder ones. The exams test your knowledge of the topic by checking how many questions you can answer correctly. It is not about answering everything to get some nine-something percent of a total number of points.

COURSE GRADING

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

Exams	300	(60 each from the two hour tests, and 180 from the final exam)
Homework	150	(accumulated by adding homework points up to a maximum of 150)
Quizzes	75	(obtained from the grades of 70% of the quizzes, the ones that got the highest grade)
Total	525	

Additional extra-credit points that can also contribute to the above total will be given based on attendance and participation in recitation or in lecture, at the discretion of recitation leaders and lecture instructor, but they will be limited to a maximum of 50 points.

The 300 exam points, as described above, will be determined by adding the points obtained in the two hour tests and in the final exam. The two hour tests together contribute a maximum of 120 points, and the final exam contributes a maximum of 180 points, for a total of 300.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

Lehigh University is committed to maintaining an equitable and inclusive community and welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact Disability Support Services (DSS), provide documentation, and participate in an interactive review process. If the documentation supports a request for reasonable accommodations, DSS will provide students with a Letter of Accommodations. Students who are approved for accommodations at Lehigh should share this letter and discuss their accommodations and learning needs with instructors as early in the semester as possible. For more information or to request services, please contact Disability Support Services in person in Williams Hall, Suite 301, via phone at 610-758-4152, via email at indss@lehigh.edu, or online at <https://studentaffairs.lehigh.edu/disabilities>.

THE PRINCIPLES OF OUR EQUITABLE COMMUNITY

Lehigh University endorses The Principles of Our Equitable Community [http://www.lehigh.edu/~inprv/initiatives/PrinciplesEquity_Sheet_v2_032212.pdf]. 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.

A NOTE ON ACADEMIC INTEGRITY

[Academic integrity](#) applies to all we do. See the links in the top-left corner when you enter coursesite, which opens some [slides/vignettes](#). Don't cheat on exams or quizzes, don't copy homework assignments. Taking care of academic integrity works to your advantage. When doing homework, some nice discussions among friends are always a good way to learn, but do try to also 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.

Lehigh University Undergraduate Student Senate Statement on Academic Integrity

We, the Lehigh University Student Senate, as the standing representative body of all undergraduates, reaffirm the duty and obligation of students to meet and uphold the highest principles and values of personal, moral and ethical conduct. As partners in our educational community, both students and faculty share the responsibility for promoting and helping to ensure an environment of academic integrity. As such, each student is expected to complete all academic course work in accordance to the standards set forth by the faculty and in compliance with the University's Code of Conduct.