Syllabus Physics 21, Fall Semester 2018

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
phy21@lehigh. edu
Office Hours: After each lecture, and on Mo/Wed from 4pm to 6pm.

HOMEWORK AND RECITATIONS, TEACHING ASSISTANTS

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Your primary contact should be your recitation leader, a.k.a your teaching assistant (TA). If you have questions or need more help with an assignment, ask during recitations, or visit your TA. Office hours will be set independently.

Ask questions, we are here to answer them. But do not just ask something like "can you give me some hints about this problem?" The most efficient way to ask questions is to always first try yourself, determine the places where you have difficulties, and then come ask questions about those. Remember that in this class there will be some fine points and insights that cannot be codified in simple rules and recipes. So ask questions about anything that seems strange.

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

How to describe and predict, quantitatively, the movement of bodies in terms of the forces acting on them. Vectors and how to use them. Ability to write and solve algebraic equations. Familiarity with derivatives and integrals, and ability to write and use integrals. Knowledge of the simplest differential equations will also be an asset.

Course contents (what we will teach in this course)

Electric and magnetic fields, their origins, and their effects. How those fields are generated, 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. The quantitative analysis of electric circuits, that is the systems that are obtained when one connects 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 know about electromagnetic fields, the origin and properties of the speed of light, and they 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, and the phenomena of electromagnetic induction, diffraction, and interference. 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 time dependence 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, 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.

Time, location, and organization

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. Depending on which recitation time-slots you chose, you may have been assigned to the 9:20am lecture time, but please feel free to switch to the 10:45 lecture (and vice-versa).

Required Materials and class activities

COURSE WEBSITE
Quick access point at http://www. lehigh. edu/inphy21/, with a summary of this syllabus and instructions on how to sign up for *masteringphysics*.

COURSESITE
Class material are available there.

TEXTBOOK
This course will use *masteringphysics* for homework assignments. The problems will be from the textbook given below, and you can get relatively cheap access to its online version when you sign up for *masteringphysics*. Note that this is an older edition, allowing you to get pre-owned books for cheap. Our course will cover the same material as in this book, *but not in the same sequence*. In addition to this textbook, there are also plenty of free resources online, see for example https://openstax.org/details/books/university-physics-volume-2.

Randall D. Knight, "Physics for Scientists and Engineers: A Strategic Approach", 3d Edition, Volumes 3 and 4, covering chapters 20 to 37 of the full book.

CLASS PLAN
On coursesite: Details as well as it can when each activity takes place, when each topic is taught.

LECTURE SUMMARIES
On coursesite: I'll be posting typeset summaries of each week of lectures. You must read them.

LEARNING HOMEWORK
On coursesite: Weekly homework assignments that are meant to stimulate critical and creative thinking and to provide a different way to learn a subject by working on it.

FULL, DETAILED SOLUTIONS OF EACH LEARNING HOMEWORK
On coursite: These are teaching solutions, going into details of the particular problem but also providing more information and explanations. You must read them even if you happen to not have done the homework.

MASTERING PHYSICS
Online homework assignments, must be handed in twice a week, on Tuesday night and Thursday night. You must sign up for the masteringphysics that is attached to Knight's textbook (see above). Go to http://www. lehigh. edu/inphy21/ for instructions on how to sign up. Note that if you want you can also sign up for access to the electronic version of the textbook.

MASTERING PHYSICS NOTES
On coursesite: I will often provide some notes and commentary about some masteringphysics problems and the way that could have been solved.

QUIZZES
Every week during the Friday recitation that will be a short quiz, mostly on topics that have just been taught or discussed in past homework. It serves to check your progress and highlight some questions that can then be discussed in recitation.

Reading Assignments

There are several resources that you can use to help you along. The class plan posted on coursesite details the material that will be discussed in every lecture, and the corresponding sections in the textbook. I will also post my own short class summaries of the material that is presented every week. In addition, I will provide a full, detailed solution of the Learning Homework, and some notes about the solutions to masteringphysics problems. Sometimes solutions will go beyond what was asked in the original problem.

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)
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 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 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)

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 obtain a full solution. In a way, the aim is often to try to solve the problem, but get stuck somewhere, fail to solve it immediately, but then use the experience to generate more questions and more understanding. This provides an alternative to the shorter masteringphysics problems that often give the impression that there is just a recipe that one must know to solve them… But that's never really the case. The Learning Homework assignments try to provide both open questions and more explanations about their topics. Use them for discussions and to generate questions and answers. For each Learning Homework, try to work with the situation described there, experiment, and then work with the solutions to understand even more what is going on.

In order to develop problem solving techniques, when working with Learning Homework assignments, you will be explicitly asked to separate the important problem-solving step of analyzing what is going on and determining a way towards a solution, and the second-step of actually working through a solution.

A learning homework assignment will be posted on coursesite at the beginning of every week. You must hand in each learning homework assignment in *two stages*. On the first Friday recitation after the assignment appears, you must hand in, a *short narrative* in English (no math) describing what you see as the physical principles that are at play in the problem, and the steps you intend to take towards solving the problem, but without any calculations. After you prepared the narrative, start immediately towards the development of the full solution, don't wait for when you will get back your graded narrative the next Wednesday. You will hand-in your *final solution*, as complete as possible, the next Friday one week after you handed in the narrative. (After the semester is on its way, you will regularly hand in, each friday, the narrative for the new LHW, and the solution Both for the LHW from the previous week.) The narrative and final solution 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.

Use both your narrative and your final solution to add written questions that your TA will then answer!

The LHW consists in general of a single problem that aims at discussing and teaching some aspects of the material in a way that is not done on masteringphysics and cannot be done in lectures. Its detailed solutions, posted Friday evening (the day you hand in your final work) on coursesite, often go beyond what was asked. 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 all 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.

If you find somewhere somehow a solution of any homework assignment, **do not use it**. Using it robs you of the opportunity to learn from problem solving practice and from understanding what is going on.

Do not hand in any Learning Homework or narrative or solution that you have copied. This will only wast the time of your TA, it is disrespectful, and goes against academic integrity. But most importantly, it is a waste of *your time* to just copy down a solution. If you feel you must copy, tray at least to doit this way: read the solution, hide it somewhere, don't look at it again, and then take a blank page of paper and try solving the problem to the end.

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.

A typical week

w i, day 1	Tuesday	Submit **MPb$_{i-1}$**	**MPa$_i$** available	**LHW$_i$** available
w i, day 2	Wednesday			Discuss **LHW$_{i-1}$, LHW$_i$, and MPa$_i$**
w i, day 3	Thursday	Submit **MPa$_i$**	**MPb$_i$** available	
w i, day 4	Friday	Hand in **LHW$_i$** narrative	Hand in **LHW$_{i-1}$**	**Quiz.** Discuss **LHW$_i$ and MPb$_i$**

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. There won't be any make-up tests.

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 wait of a midterm. As an example, the final grade will be calculated via

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

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 $(m_i + 2\, f)/3$, where m_i is the grade of the other midterm. Or if the 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 is dangerous** with past statistical analysis showing that it does indeed reduce the average class grade for each hour test. The reason is that when people know that the result of a test will be thrown away if they are bad, they have less motivation to study and do well. Because of this rule you might procrastinate and not work enough towards the mid-terms. **Do not do that**! Not working for the mid-terms is a **really bad idea** that makes it much more difficult for you to keep up with the material. Besides, doing well on the mid-term will alleviate a lot of anxiety because the grade you get **helps towards the final grade**. Also, what you study for the mid-terms is something you won't need to work with as much when studying for the final exam!

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 based on attendance and participation in recitation or in lecture, at the discretion of recitation leaders and instructor, but they will be limited to a maximum of 50 points.

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]

How the various elements fit together, and other general comments

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

The material to be learned in this course will come from multiple sources (lectures, recitations, textbooks, homework, reading-assignments). Classrooms meeting will serve to introduce new concepts and as a guide to the connections between different topics. They will also highlight the most important ideas. Recitations are for questions, problem-solving, and going deeper in some additional topics. Homework assignments solidify what has been introduced in lectures by allowing the students to apply the concepts and techniques they just learned.

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, and the practice in problem-solving that you get by doing the weekly homework assignments. The lecture and the other activities are integrated. I designed how the material that you will learn is transmitted to you via lecture, recitations, reading assignments, various kinds of homework assignments, the corresponding solutions, and the examples discussed in class.

Therefore, to profit from this course you must do everything. Sometimes it is useful to introduce a new concept in a homework, other times this happens in a reading assignments or in class. Sometimes there is a deeper explanation of a particular technique in the solutions to the "learning homework". Sometimes we calculate through an example in class, but often you should do your own math, working through examples outside of class. Our limited class time is better used for explaining and connecting concepts instead of detailed number-crunching.

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 class! It is worth stressing that, given the time-constraints, it is impossible for me alone to tell you in lectures everything that you need to learn, but I can guide you by highlighting the most important things.

Important advice

You cannot learn physics without doing lots of independent homework, in particular problem solving. It's the practice of using the concepts that makes you learn and understand them. Note also that the lectures are too short to talk about everything there is to learn. You must do all the course activities to get all the information you need:

PRACTICE PROBLEM SOLVING

Getting into the habit of obtaining hints and help on a homework assignment before trying to do it yourself 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).

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 used to understand the issues, set up some basic relationships, *and then, once you have an idea about what to do*, start thinking about equations. Equations are the mathematical description of a *relationship*. Don't look for formulas with the thing you are interested in on the left-hand side. Use algebra for as long as you can. At the end you will get a formula that represents your solution, but it will be an algebraic expression that you derived yourself. Only plug-in numbers at the end.

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 openstax, to wikipedia to anything else that you might find useful (see the last section below).

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 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!

COPYING

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!! **Don't go to a tutoring class to just get "hints" about solving problems.** 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.

Also, do note that I am not responsible for trying to impede you from going out and finding old versions of homework that come with solutions, or some other pre-made, pre-canned solution. But if you do that, you will not learn problem-solving, you will miss important practice, and you will not learn the material. If somebody gives you an old version of a homework with solutions, throw them away, and try to attack the problem yourself. If you have troubles, look for info in the textbook, describe your difficulties to your TA, come ask questions.

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.

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 Asimov's *"Understanding Physics: Volume 2: Light, Magnetism and Electricity"* for $4 (check the usual on-line bookshops). Get it, read it. I am sure it will help.

Physics 21

Fall Semester 2018

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

Time Plan

Wk	Date	Day	reading assignment	Topic	HW & Quizzes
1	08/28	Tu	25.1-25.3, **25.4**, **25.5**	Point charges, electric fields, Coulomb law	
		W		Vectors, Sum of Electric fields.	
		Th	**26.1**, 26.2-26.3 **26.5**	Typical electric fields. Superposition, Continuous charge distribution.	MPa1
		F	26.3-26.4, 26.7	Integrals (to find field), field lines, flux. Dipole.	Quiz 1 LHW1 narrative
2	09/04	Tu	27.1-27.3, **27.4**, 27.5-27.6	Electric Field, Symmetry, and Gauss law, Conductors.	MPb1
		W	27.5, 28.2, 28.7	Gauss, conductors	
		Th	**28.1, 28.2**, 28.3-28.5, **28.6**. 29.1-29.3, 29.7	Electric potential. Electric polarization	MPa2
		F		Review Electric Potential	Quiz 2, LHW1 LHW2 narrative
3	09/11	Tu	32.1-32.2, **32.3,** 32.4 **32.6**	Magnetic field of a moving charge. Simple electric currents. Field lines, Ampère Law.	MPb2
		W	32.3	B-field of moving charge, vector product	
		Th	**32.4**, 32.5, **32.6**	Magnetic fields and electric currents. Field lines, Ampère Law. Solenoid.	MPa3
		F	32..3	Reminder of vector product.	Quiz 3, LHW2 LHW3 narrative
4	09/18	Tu	**32.7**	Magnetic force on moving charge and current carrying wires.	MPb3
		W	32.9	Lorentz force. Force between wires.	
		Th	**32.7**, **32.8**, 32.9	Magnetic force on moving charge and current carrying wires. Magnetic Torque on loops.	MPa4
		F		Review of Magnetostatics	Quiz 4, LHW3 LHW4 narrative
5	09/25	Tu	Ch. 25 to 32 33.1, **33.2**, **33.3**, 33.4	Review, electric and magnetic fields, forces Magnetic flux, Electromotive force (emf).	MPb4
		W			**MID-TERM 1**
		Th	**33.3**, 33.4, **33.5** 33.6.	Faraday Law, Lenz, Eddy currents, General form of Ampére Law. Displacement current.	
		F	33.7	Examples of induction, eddy currents	LHW4 LHW5 narrative

Note: reading assignments give section numbers in textbook that discuss lecture topics. Bold-faced section numbers are “milestone” section numbers where important concepts are presented.

Wk	Date	Day	reading assignment	Topic	HW & Quizzes
6	10/02	Tu	34.2, 34.3, **34.4**	General form of Ampére Law. Maxwell's equations,	MPb5
		W		E and B fields creating each other	
		Th	34.5	Electromagnetic waves. Speed of Light.	MPa6
		F	34.5	Electromagnetic waves.	Quiz 5, LHW5 LHW6 narrative
7	10/09	Tu	34.1, 34.5, **34.6**. 34.7.	Electrodynamics in different reference frames. Energy density, Poynting vector.	MPb6
		W	34.6	Poynting vector	
		Th	26.5, 29.2, 30.1, **29.5**-7. 30.2-4, 30.5	Electrodynamics and Relativity. Introduction to circuits.	MPa7
		F			Quiz 6, LHW6 LHW7 narrative
8	10/16	Tu	Pacing Break		
		W	30.5, 31.1	Repeat intro circuits	
		Th	31.2, 31.3, 31.4, 31.6, **31.7**, 31.8, 31.9, 29.7	Kirchhoff rules, RC Circuits, power, and energy in capacitors, dielelctrics	MPa8
		F	31.5	Batteries, internal resistance	Quiz 7, LHW7 LHW8 narrative
9	10/23	Tu	**33.8**, 33.9, **33.10**	Inductance, Energy density of magnetic field, LR and LRC circuits, circuits with switches	MPb8
		W	33.7	Mutual inductance, transformers	
		Th	33.9, 33.10, 35.1 35.2-35.5, **35.6**	Time dependent currents and voltages. Intro to AC circuits, root mean square values, power	MPa9
		F		Examples, power for AC currents	Quiz 8, LHW8 LHW9 narrative
10	10/30	Tu	Chapters 31, 33-35 29.5-7, 30.1-5	Review of Electrodynamics, Maxwell's equations, electromagnetic waves, circuits.	MPb9
		W		Review	**MID-TERM 2**
		Th	35.2-35.5	AC Circuits, Reactances	
		F	35.6	Power in AC circuits	LHW9 LHW10 narrative

Note: reading assignments give section numbers in textbook that discuss lecture topics. Bold-faced section numbers are "milestone" section numbers where important concepts are presented.

Wk	Date	Day	reading assignment	Topic	HW & Quizzes
11	11/06	Tu	20.1-20.4, **21.1**, 21.5, 21.6, **34.7**	Waves, Light Waves, Polarization, Refractive index	MPb10
		W	20.1-20.4	Waves, amplitude, phase, frequency, wavelength	
		Th	21.7 22.1, 22.2	Reflection, constructive and destructive interference. Double-slit diffractions	MPa11
		F	22.3	Diffraction gratings and diffraction orders	Quiz 9, LHW10 LHW11 narrative
12	11/13	Tu	22.2, **22.3**, **22.4,** 22.5	Single slit diffraction, interference and diffraction patterns	MPb11
		W	23.3	Refraction. Examples of total reflection and transmission	
		Th	21.6, 23.1-23.4	thin-film interference, introduction to lenses.	MPa12
		F	23.5	Wavelength and color	Quiz 10, LHW11 LHW12 narrative
13	11/20	Tu	23.6-23.8	Ray Optics, Mirrors and Lenses. Imaging.	MPb12
		W	Thanksgiving Break		
		Th			
		F			
14	11/27	Tu	24.1-24.4	More imaging, Ray tracing.	
		W	24.4	Imaging Examples, Microscopes	
		Th	24.5 38.3, 38.4	Summary of optics.	MPa13
		F	24.4	Imaging Examples, Telescopes	Quiz 11, LHW12 LHW13 narrative
15	12/04	Tu		Summary and Review. Interference with particles? What's next?	MPb13
		W		Review	
		Th		Review	MPa14
		F		Review	LHW13

Note: reading assignments give section numbers in textbook that discuss lecture topics. Bold-faced section numbers are "milestone" section numbers where important concepts are presented.