Syllabus for Physics 222, section b, fall 2020

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prerequisites The prerequisites are Physics 221 and Math 152 with a grade of C or better.

office hours My office hours are TR 2-4:45. Call my landline, 714 525 8466, and we'll set up a zoom session. If you need help at a different time, feel free to give me a call and see if I'm available. Please only call between 7 am and 7 pm.

web page `www.lightandmatter.com/area3phys221.html`

required materials The text is *Fields and Circuits*, which can be downloaded at `lightandmatter.com/fac`. Printed copies are available at `lulu.com/spotlight/benjamin_crowell` for $14.60. I don't receive any royalties from sales of the printed book.

If you're a physics major with a strong mathematical background, I recommend that you also buy and read a copy of Purcell, *Electricity and Magnetism*, a beautiful, classic book. Old editions can be found for $5-10 through aggregators like `bookfinder.com`. Although the old editions use a non-SI system of units, that only affects some of the numerical constants appearing in formulas, which is not a big issue in a book being used for this supplementary purpose.

getting started Here are the things you need to do by the second class meeting:

1. Read this syllabus.

2. Consult the schedule on page 5. Do the listed reading and the homework problems. Take notes on the reading.

recommended weekly routine The following is a typical way that you could allot your time for this course during a week in which there is one reading assignment and two homework assignments.

	hours	
Read (first pass).	1	
Read (second pass, typing notes).	0.5	
Work alone on homework (first shot).	1.5	1.5
Tutoring/office hours.	0.5	0.5
Work alone on homework (second shot).	1	1
misc. (lab writeup, . . .)	1	
total	~ 8	

grading Grades will be determined as follows:

homework	100 problems @ 0.1 point each	10
reading quizzes	24 questions @ 2 points each	48
labs	11 @ 20 points each	220
weekly exams	13 @ 30-60 points each	700

points	grade
80%	A
69%	B
58%	C
47%	D

The reason for grading the homework is to give you feedback and track your progress. To avoid giving anyone an incentive to cheat by copying solutions from online or offline sources, I've made the weight assigned to the homework too low to have any significant direct effect on your grade. However, the way you learn the material in this type of course is by practicing. Therefore most students end up with about the same grades on the exams as on the homework.

basic literacy in calculations	The following are some common mistakes in carrying out a numerical calculation.

wrong	right	
$\dfrac{2(1.36)}{(0.53)^2} = 9.7$	$\dfrac{2(1.36 \text{ m})}{(0.53 \text{ s})^2} = 9.7 \text{ m/s}^2$	Never write numbers without units. When plugging in, check that the units work out to be what you expected.
$1.37 \text{ m} = \frac{1}{2}a(0.53 \text{ s})^2$ $1.37 \text{ m} = (0.140 \text{ s}^2)a$ $a = 9.7 \text{ m/s}^2$	$x = \frac{1}{2}at^2$ $a = \frac{2x}{t^2}$ $a = \frac{2(1.37 \text{ m})}{(0.53 \text{ s})^2}$ $a = 9.7 \text{ m/s}^2$	Finish the algebra before plugging in the numbers.
Volume of one ton of helium: $V = \frac{m}{\rho}$ $V = \frac{1000000 \text{ g}}{172 \text{ g/m}^3}$ $V = 5813.95 \text{ m}^3$	Volume of one ton of helium: $V = \frac{m}{\rho}$ $V = \frac{10^6 \text{ g}}{172 \text{ g/m}^3}$ $V = 5.81 \times 10^3 \text{ m}^3$	Use scientific notation. Put your calculator in scientific notation mode. Don't waste time writing down lots of insignificant figures.

reading-based class, flipped classroom	The organization of this class is based on a belief in the primacy of written language.

This class will use what's known as a flipped classroom technique. That means that you'll encounter all the material first by reading the book. Class time will not be used to present the material from scratch, but instead for activities designed to deepen your understanding and help you clarify points that you had a hard time understanding just by reading. These activities will include student questions, demonstration, examples, small-group discussion, and whole-class discussion. For a fairly recent meta-analysis of educational studies supporting the use of this technique, see Von Korff et al., "Secondary Analysis of Teaching Methods in Introductory Physics: a 50k-Student Study," Am. J. Phys. 84, 969 (2016), `arxiv.org/abs/1603.00516`.

As soon as you're done with a reading assignment, you should go back through and type up notes on what you've just read. You should do the notes on a computer (for ease of revision), and do them after you read, not while reading (so that you know what ended up being the main points).

There will be a short multiple-choice reading quiz on every reading assignment. I'll distribute all of these as a PDF file at the beginning of the semester. The quizzes are due at the beginning of class. Because the quizzes can be done at home and are open-notes, I expect that very few people will get any of the questions wrong, and normally you will just be able to confirm this because the points will show up on your online grade report. If you get a question wrong, I'll let you know by email.

When writing your notes, shorter is better. The laws of physics are fundamentally simple. I would suggest limiting yourself to no more than quarter of a page per chapter. By the end of the semester, the simple underlying structure of the material will have become more and more obvious to you, and I think you should be able to go back over your notes and edit them down to no more than about a page *total*. It's not against the rules for your notes to be too long, but it's not smart, either; long notes usually indicate that you're not distinguishing fundamental principles from trivia, or that you're making futile efforts to write a cookbook of problem-solving techniques, which is a self-defeating way to approach problem solving.

Any time you feel like showing me your notes, I would be happy to give you feedback on them.

Google Docs for note-taking	For note-taking, I recommend that you use Google Docs, `docs.google.com`, which makes it easy to do equations. It works in any web browser, and you don't have to install any software. To do an equation, go to the Insert menu and choose Equation. You can then type in your math. A toolbar also comes up, just above the top of the page, with symbols in it like square roots. I found the toolbar confusing when it came to doing exponents; the easiest way to do it is to enter, e.g., `x^2` for x squared. Printing works, but is a little awkward and ugly. A PDF

file pops up, with your equations rendered at low resolution. You then have to print the PDF file (i.e., you have to do two print commands in order to get the output to actually go to the printer).

Spotter
Spotter is computer software I've written to help you check your answers to homework problems. It can check both numerical answers and symbolic ones. Having Spotter helps you more than having answers in the back of the book, because it is programmed to give you helpful pointers. If you put in an wrong answer that I've anticipated, it will explain why it's wrong. If your answer doesn't make sense in terms of units, it will tell you that. If you get a wrong answer, you can redo the problem and put in the right answer later for full credit.

Problems labeled as online on the homework page of the syllabus have purely mathematical answers, and are in Spotter. To get credit for an online homework problem, you need to enter a correct answer in Spotter, and also turn in your written calculations and explanations along with the rest of the homework. What I'm really trying to do here is get you to come to my office hours and get help if you can't get the right answer — Spotter helps you by letting you know whether you have the problem right *before* you turn it in.

You don't need to install the software; you just use it through a web browser. Start from the class's web page, then click on the "homework" link to the class's Spotter page. Once you're in Spotter, make sure to log in, or else you won't get credit for your work! Once you're logged in, all your answers will be recorded.

When using Spotter, you have to be careful about the notation you use for inputting mathematical expressions. Spotter is designed to allow you to use something resembling normal human mathematical notation, as opposed to the notation used in computer programs. However, human math notation is designed for humans, not computers, and you need to learn a few things about how to type your expressions in a form that Spotter will interpret correctly.

First, everything you type will be smashed down to one line of text, eliminating the superscripts and subscripts. For example, a variable name with a subscript, like x_1, is entered as x1. Since there are no superscripts, you have to enter exponents using the ^ symbol (shift-6), e.g., x^2 becomes x^2. You can enter a square root as either sqrt(x) or x^.5. There is no way to enter the times symbol, $\times$, without confusing the computer and making it think you meant the variable x, so in scientific notation you should simply leave a space where you would normally put the times symbol, e.g., 5×10^6 becomes 5 10^6. Don't try to enter this as 5e+6; that's what a lot of computer software would want, but Spotter is trying to interpret everything as normal human notation, so it will think you meant $5e + 6$, where e is a variable.

Human languages, including human math notation, are ambiguous. Use parentheses liberally to make your meaning clear. There are two main situations where you need to watch out. First, arguments to functions: sin 2x will be interpreted as $(\sin 2)(x)$; if you intended $\sin(2x)$, you should have entered sin(2x). Second, the bottom of fractions: 1/3c will be interpreted as $(1/3)c$, so if you want $\frac{1}{3c}$, you need to enter 1/(3c).

As you type your answer, the computer will display a rendering of it into "real" human math notation so that you can see how your input is being interpreted. If you're using this feature in a browser such as Internet Explorer that has poor math support, it will be slow, especially the first time you use it on a particular computer.

academic honesty policy
In cases of serious academic dishonesty, I will assign a zero on the work, and I will also pursue action at the college level, which may result in penalties such as suspension or expulsion.

Serious academic dishonesty includes cheating on an exam, or turning in homework that is plagiarized from my solutions or from a source such as Chegg.

I will also assign a zero in cases where two students turn in homework or lab reports that contain identical or nearly identical work. A good rule of thumb is that if A is helping B, only B's paper should be out, and the pen should be in B's hand.

drops I will drop you if you don't turn in two of the weekly exams in a row.

communication and turning in work Quizzes and homework will be turned in through email. To help me keep things organized, please send these emails with a subject line that looks like this:

p222bq13, Jane Smith

"P" is for physics, the first number is the course number, "b" refers to which section it is, "q" means it's a quiz, and 13 means it was the quiz on chapter 13. For homework, use a code like p222bh28, meaning Physics 222, homework 28. Use "l" for labs and "e" for exams. Using these codes will cause my server to sort your email into the appropriate in-box for graded work.

Don't use these codes if you want to ask a question, set up a Zoom, etc., because I won't look at these emails until afer the assignment is due when I'm grading it.

When you're sending an email to ask a question or for some other purpose, but not to turn in work, just use a detailed, descriptive subject line, e.g., "question about the right-hand rule for the Poynting vector." It's fine to send me a draft of some work, e.g., your partially complete work on a homework problem that you need help on. If doing this, use a descriptive title such as "FAC 9-13, power in series, is this right?"

You can send me your work as a plan text email, cell phone photo of a handwritten page, a PDF file, or some mixture of those things. When people in STEM email each other about stuff involving math, sometimes they use a plain-text version of the math, e.g., `Delta x = x_1 - x_2`.

attachments and their size When submitting work as a camera image or pdf file, please send it as an attachment, not a link to some external repository such as a dropbox account.

It will cause problems if you send photos that are large and high resolution. This can lead to results like your mail bouncing back with an error about its size, or your mail being delayed because my in-box reaches its maximum size. For a photo of a single page of your writing, the file size should be something like 0.1 to 0.5 Mb. If you have a fancy smartphone that takes high-resolution photos, then you should reduce the resolution when you send the images.

If you're using an ipad or iphone, I believe the following instructions will work for reducing the sizes of images. When you mail a photo using this user interface, there is a step where you tap "Share." At this point, it should give you a menu of choices for the compressed size, with sizes of small, medium, large, and actual. Choose one of the smaller sizes. You may wish to check by sending yourself an email what size is the smallest that leaves your writing legible.

If you're using software that creates pdf files, a quick and easy way to reduce the pdf's size before emailing it is to use a service such as `https://smallpdf.com/compress-pdf`.

Schedule for Physics 222, section b, fall 2020

Date	Day	read ch.	hw	topics	lab†
Aug.25	Tu			Electric and magnetic fields	
	Th	1*	1**	... practice exam	
Sep. 1	Tu	2	2	Gauss's law... exam 1	c2.1 field of a permanent magnet
	Th		3		
8	Tu		4		
	Th	3	5	Models of matter... exam 2	
15	Tu	4	6	The electric potential	c2.4 electric potential
	Th		7	... exam 3	
22	Tu		8		
	Th	5	9	Electromagnetism... exam 4	
29	Tu		10		c2.5 the dipole and superposition
	Th	6	11	Radiation... exam 5	
Oct. 6	Tu		12		c2.6 polarization
	Th	8	13	Resistance... exam 6	
13	Tu		14		c2.7 the oscilloscope
	Th	9	15	DC circuits... exam 7	
20	Tu		16		c2.8 electromagnetism
	Th		17	... exam 8	
27	Tu		18		c2.9 electrical measurements
	Th	11	19	Sources of magnetism... exam 9	
Nov. 3	Tu		20		c2.10 the loop and junction rules
	Th		21	... exam 10	
10	Tu	12	22	Resonance, complex numbers***	c2.13 RC circuits
	Th	13	23	AC circuits	
17	Tu		24	... exam 11	
	Th	14	25	Impedance	
24	Tu		26	... exam 12	c2.14 AC circuits
	Th			*Thanksgiving*	*Thanksgiving*
Dec. 1	Tu	15	27	Stokes's theorem... exam 13	c2.15 Faraday's law
	Th		28		
8	Tu		29		
	Th			... exam 14	

* Before each class that has assigned reading, do the reading, take notes, and turn in the reading quiz. See pp. 2-3 for details.

** Turn in your papers showing all the work you did on the homework, including the online problems. The list of problems for each homework is on p. 6.

*** Also watch the video on mechanical resonance, linked to from the class's web page.

†Most or all of the lab work will be done on your own time, not during class time. Each lab is listed on a certain date. You are responsible for reading the lab by that date, which is also a good time to ask questions in class if there are things you didn't understand. For labs that have a "preparation" section, try to do the prep by the date when the lab is listed, and we may discuss it in class. Each lab is due 7 days after the date when it was listed.

exams Exams will be at the beginning of the classes shown above. They will be 20-40 minutes long. I will be online in zoom in case you have a question about the exam. I will appreciate it if you are also online with your video on during this time. Turn in your exam using the method described on p. 4. To allow for possible technical issues or getting stuck in traffic, I will not count your lowest test grade.

Exams will be cumulative but will concentrate on more recent material. The topics and difficulty of the exams will be coordinated with the homework, and as much as possible will be arranged so that you have had feedback on homework problems that are on the same topic and at a similar level.

Homework assignments

A notation like 2-5 means chapter 2, problem 5.

Problems labeled "online" are in Spotter, which is explained in the syllabus. The full statement of each problem is in the book, not in Spotter. For these problems, you have to do *both* of the following things to get credit: (1) check the answer in Spotter and get it right, and (2) show your work on the paper that you turn in. If you're getting the wrong answer in Spotter and don't know how to get it right, please come to my office hours for help! My office hours are listed on the front page of the syllabus.

I'd appreciate it if you would leave about an inch of empty space at the top of the front page of your homework, so I can write your scores on the problems there.

Solutions for some problems, marked with an "s" below, are given in the back of the book. Try to solve these without peeking at the solution, then use the solution to check yourself. These problems are not for credit, and you don't need to turn in your work.

Problems labeled * are more difficult problems that are not required and are meant for students at the top of the bell curve who don't find the regular homework challenging. These are not for points, but if you do one and would like feedback, please write me an eye-catching note on your homework paper so I'll know to look at it.

Note that in many of the homework problems, you need to look up data in the back of the book.

If a problem doesn't exist in your printed copy of the book, you can get it in the latest online version of the book at lightandmatter.com.

Homework 1
paper only   *online and paper*
1-3 1-5 1-6$_s$ 1-1 1-2 1-4 1-7 1-8

    FAQs about Spotter: (1) The full statement of the question is in the book, not in Spotter. (2) Spotter has every problem, not just the ones assigned to you.

Homework 2
paper only   *online and paper*
1-12 1-17$_s$ 1-18$_s$ 1-9 1-10 1-11 1-13

Homework 3
paper only   *online and paper*
2-1$_s$ 2-3 2-10$_s$ 1-15 2-2 2-5 2-6

Homework 4
paper only   *online and paper*
              2-7 2-11 2-13

Homework 5
paper only   *online and paper*
2-9   2-8 2-12 2-14* 3-5

Homework 6
paper only   *online and paper*
3-4 4-1$_s$ 3-2 3-3 3-6 3-7* 4-2

Homework 7
paper only   *online and paper*
4-3$_s$ 4-4 4-5$_s$ 4-9$_s$ 4-10   4-6 4-7 4-8 4-11 4-12 4-14 4-19$_s$

Homework 8
paper only   *online and paper*
4-17 4-23*   4-18 4-20 4-21

Homework 9
paper only   *online and paper*
4-16 4-22* 4-24* 5-22$_s$ 4-15

    Problem 5-22 may not be in your printed book, so you may need to download the latest online version.

Homework 10
paper only
5-1 5-2$_s$ 5-21

online and paper
5-4

Homework 11
paper only
5-3 5-13 5-14 6-1

online and paper
5-12

Homework 12
paper only
5-5 5-15$_s$ 6-3$_s$ 6-5$_s$

online and paper
5-16 5-17 5-20 6-2 6-4

Homework 13
paper only
6-6$_s$ 6-7* 8-1$_s$

online and paper

Homework 14
paper only
8-6$_s$ 8-9

online and paper
8-2 8-3 8-4 8-5 8-7 8-8

Homework 15
paper only
8-11

online and paper
9-3

Homework 16
paper only
9-2 9-10$_s$

online and paper
9-8

Homework 17
paper only
9-6 9-11

online and paper
9-9 9-12 9-13

Homework 18
paper only
9-14 9-15$_s$

online and paper
9-16

Homework 19
paper only
9-18

online and paper
11-1

Homework 20
paper only
11-4

online and paper
11-2 11-3 11-6

Homework 21
paper only
11-5 11-13*

online and paper
11-7 11-8

Problem 11-13 may not be in your printed book, so you may need to download the latest online version.

Homework 22
paper only
11-9 11-11* 12-2$_s$

online and paper

Before doing problem 11-11 You may want to warm up with the preceding problem in the book.

Homework 23
paper only
12-3$_s$ 12-5$_s$ 12-9 12-12

online and paper
12-1 12-4 12-10 12-11 13-1

Problem 12-12 may not be in your printed book, so you may need to download the latest online version.
Problem 12-11 may not be in your printed book, so you may need to download the latest online version.

Homework 24
paper only
12-6 12-8* 13-2$_s$ 13-9$_s$ 13-10

online and paper
13-3 13-4 13-7 13-8

Homework 25
paper only
13-5

online and paper
13-6

Homework 26
paper only

online and paper
14-1

Homework 27

paper only

14-4

online and paper

14-2 14-3 14-5

Homework 28

paper only

14-7 15-1

online and paper

14-6 15-3 15-4

Homework 29

paper only

15-2 15-7

online and paper

Problem 15-7 may not be in your printed book, so you may need to download the latest online version.

students with disabilities Fullerton College is committed to providing educational accommodations for students with disabilities upon the timely request by the student to the instructor. Verification of the disability must also be provided. The Disability Support Services office functions as a resource for students and faculty in the determination and provision of educational accommodations. (Faculty Resource Guide at http://staffdev.fullcoll.edu/)