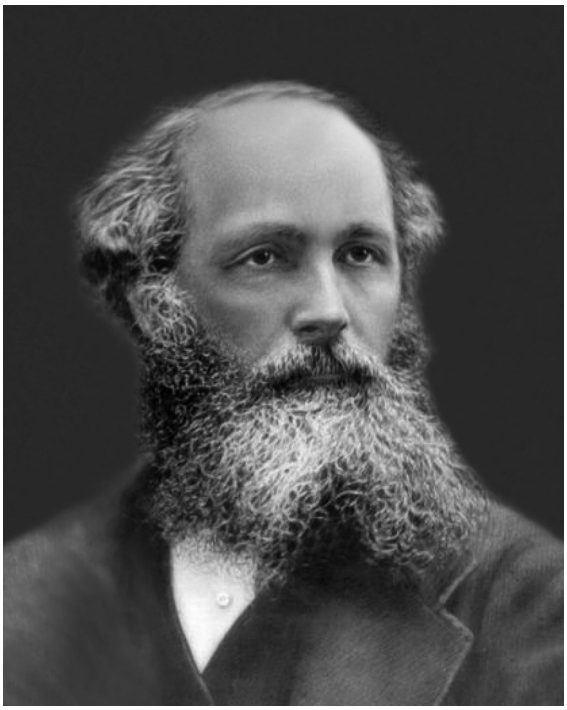
Physics 22, Section 3326



James Clerk Maxwell

Fall 2019

Physics 22 is a calculus-based introduction to the physics of electricity and magnetism. The class is aimed to give you a solid foundation for the laws and principles of electromagnetism, and to develop problem-solving skills with the use of logic and deductive reasoning. The class is quite heavy in single-variable calculus, and there will even be concepts of multivariable calculus introduced in the process. Of course, the class is self-consistent in this respect, and there will be considerable emphasis on the development of physical insight to help understand such multivariable-calculus notions. In some ways, this class will likely teach you more about such calculus than a math class would, as you actually develop physical intuition about an otherwise abstract presentation of the material that you will encounter from a mathematician's perspective. I will try my best to review all of the necessary mathematical and physical concepts and techniques required to succeed in the course. Obviously, you must also do your share in putting in the necessary amount of time to become proficient in the mathematics, as well as the physics. Part of the process of comprehending the material is to ask questions and to learn from your mistakes and misconceptions. Think of me as the guide that helps facilitate that process. Indeed, my job as an instructor is to help you achieve educational enlightenment and mastery in the topics that will be covered in class, so please feel welcome to ask for help whenever you need it.

Prerequisites

Math 8
Physics 21

Course

Physics 22 (5 Units)
Lecture/Lab:

- M 8:00 am - 10:30 am in SCI 122
- W 8:00 am - 10:30 am in SCI 122
- F 8:00 am - 10:00 am in SCI 122

Text

A textbook is required for this course, but a specific one has not been assigned. You may use any calculus-based physics textbook aimed at students pursuing physical science and/or engineering. The following list contains various textbooks that are appropriate as a supplement/reference for this class. Feel free to use one, or more, of them.

- *Resnick/Halliday/Krane*, Physics, any edition (currently on 5th Edition)
- *Serway/Jewett*, Physics for Scientists and Engineers with Modern Physics, any edition (currently on 10th Edition)
- *Knight*, Physics for Scientists and Engineers, A Strategic Approach, any edition (currently on 4th Edition)
- *Halliday/Resnick/Walker*, Fundamentals of Physics, any edition (currently on 11th Edition)
- *Young/Freedman*, University Physics, any edition (currently on 15th Edition)

Instructor

Dr. Emin Menachekanian

- Office: SCI 273
- Office Hours:
  - M 10:45 am - 12:00 pm
  - W 10:45 am - 12:00 pm
  - F 10:15 am - 11:45 am
  - Or by Appointment on MWF (scheduled in advance)
- Office Phone: (310) 434-4899
- E-Mail: menachekanian_emin@smc.edu
- Class Web Page: http://homepage.smc.edu/menachekanian_emin/physics22.htm

Strategies & Advice

Every student is different in the way that s/he learns both inside and outside of the classroom. I will try my best to show you a variety of ways—both conceptual and quantitative—in approaching the multitude of topics that we will be covering in this class. However, there are some common denominators in achieving mastery in the material. The following are a few pointers, among probably others, that will undoubtedly help you in the inevitable learning curve associated with this class.

- Devote at least 10 - 20 hours PER WEEK on this class, OUTSIDE OF CLASS!
  - Read relevant sections from your chosen book(s) at least twice. Of course, it would help to read the section(s) in advance, so that you have some premonition before coming to the class devoted to studying said section(s), or before attempting the assignments.
  - Do the assigned coursework (homework and lab worksheets).
  - Take diligent notes from class, and make a habit of reviewing them after class (at least before the end of the day).
- Work on the class material consistently!
  - As a good analogy, consider how an athlete trains. S/He does not develop expertise by training once per week for a ridiculously extensive period of time. Instead, s/he improves by training progressively through the week with a well-organized schedule.
  - Try to take some time to build up a schedule for yourself. On the schedule, do not just place the time during which you will be in your various classes, but include all of your other commitments (e.g., commuting to and from school, working, sleeping, hanging out with family/friends, etc.) to see if you even have realistic time to devote to studying consistently for this (or any other) class.
- Attempt the homework without too much reliance on solutions!

  - Practically all of the problems have worked-out solutions on either physics forums, webpages, or solution manuals. Mastery of the material requires the ability to reason, analyze, and execute solutions to problems from first principles. With proper practice, persistence, and guidance, you can achieve such proficiency, but it takes commitment, as well as integrity, to truly and confidently understand the concepts, procedures, and outcomes involved in solving problems.
  - Here is a good way to asses this: Given a random set of homework problems, can you, on your own, write up a full solution while justifying all of your steps in working out the solution, as well as provide good background on the conceptual underpinnings associated with the problem?
  - It is also important to try to make connections between homework problems (usually in a given assignment, but perhaps across assignments as well), as it will give you a much more cohesive framework regarding the application of concepts and techniques.

- Realize that making mistakes is part of the process!
  - Learning does not happen seamlessly, and anything worth learning will necessarily require embarking on a learning curve.
  - Intelligence is a trait that is acquired through hard work, dedication, and *challenging oneself* to learn new things.
    * For more information, look up "neuroplasticity."

- Form study groups, particularly if you thrive in a group-learning environment!
  - Studying with others—although not everyone's cup of tea—is, nonetheless, a powerful tool that may help those many students who enjoy learning by collaboration.
  - Studying in groups can also promote camaraderie, as well as give students the opportunity to keep each other in check in terms of keeping pace with the material.

- Seek help when you reach a road block!
  - There is nothing wrong with seeking help; in fact, it is highly encouraged, as it is very difficult to master a subject without guidance from someone who has already developed an expertise in the field of study.
  - Seeking help on solving a problem or overcoming a conceptual misunderstanding is always more fruitful when you have consciously made an effort to resolve it yourself, as you'll develop some ideas in the journey towards resolution.
  - As an instructor, I am here to help, but I can't do so if you don't take the first step to seek it out.

- Try to internalize the content to develop a passion for the subject matter in promoting self-motivation!
  - Make the topics relevant to your own interests in life to develop an appreciation for the subject matter.
  - I will try to do this to the best of my abilities, but it never hurts to extend the things learned in this class (or in any other class, for that matter) to gain new perspectives in your journey through life.

Grading

Physics 22 is split up into the following percentages that will be used to determine your grade for the class:

Final Exam	35%
Midterm Exams	40%
Quizzes	10%
Laboratory	10%
Participation	5%

The grade for the class is determined via a weighted average, where the weight is determined by the percentages above. Mathematically (in percentage units):

$$\text{Course Grade} = 35F + 40M + 10Q + 10L + 5P.$$

Your letter grade is *ideally* determined from the following scale:

A: 90-100% B: 80-89% C: 70-79% D: 60-69% F: $<$60%

It is probable that the cutoffs for a particular grade may be lowered at my discretion. This will depend on the distribution of grades, as well as my expectations of the range of grades that deserve to fall in a particular letter-grade slot. Such an action would only improve your chances of getting a better grade. If you wish to drop the class, for whatever reason, it is **YOUR** responsibility to ensure that the appropriate paperwork is completed and submitted in a timely fashion.

A student who does not take the final will automatically receive a grade of "F" in the class, regardless of the student's performance in the class up to the final.

Final Exam

The final exam will take place on

Friday, December 13, 2019 from 8:00 am - 11:00 am

ALL STUDENTS MUST ATTEND THIS EXAMINATION AT THIS TIME!

Quizzes & Exams

Quizzes will be administered throughout the course and will be announced ahead of time. The quizzes will be quite rigidly based on problems and concepts covered in the homework. In this respect, quizzes are a more direct way in which you will be held accountable for completing your homework. They are intended to keep you honest about your homework regimen and your comprehension of the material. Moreover, these quizzes are also administered to urge you to ask for help more consistently, especially if you find yourself struggling with the course content on a regular basis. **The lowest quiz score will be dropped.**

There will be 3 midterm exams which will take place during class-time. The dates of these exams, as well as the percentage of the total grade of each exam, are as follows:

Midterm 1	**(10%)**	***Fri, Sep 27***
Midterm 2	**(14%)**	***Fri, Oct 25***
Midterm 3	**(16%)**	***Fri, Nov 22***

The midterm exams are meant to test you on a broad range of topics covered up to a certain point prior to the examination. The final exam will be a cumulative exam. In other words, it will cover topics spanning every thing we have learned in the entire course, but with a bit more emphasis on the material towards the end of the semester on which you have not been tested. My strategy in having these exams is to try to prepare you for the difficulties you may encounter in four-year universities, where it is not uncommon to have 80% (or more) of your grade determined from one or two exams, particularly in science courses. I want you to take all the exams seriously, because it will certainly sharpen your study skills in order to prepare you for such high-pressured situations.

Aside from a scientific, non-graphing calculator, absolutely no form of electronics may be used during exams, such as smart phones, cell phones, laptops, tablets, etc. For those of you who have trouble reading and/or understanding English, you may use a basic English translator. Anyone using any form of unauthorized electronics, cheating, or helping someone cheat during a quiz or exam will automatically receive a score of ZERO for that quiz or exam. Furthermore, you will be reported to Santa Monica College's disciplinarian.

Quiz/Exam Make-Up

Missing a quiz will only be excused under ***extenuating circumstances***. Note that since the lowest quiz score is dropped (as mentioned above), missing a quiz without an extenuating circumstance still can be "made up" in this way (i.e., the missed quiz will count as the quiz that is dropped). No more than one quiz can be excused based on an extenuating circumstance.

Missing a midterm exam will also only be excused under ***extenuating circumstances***. At that point, depending on the timeline, either the exam will be made up, or the percentage for that exam will be distributed among the other midterm exams and/or the final. No more than one midterm exam can be excused.

There is no make-up for the final exam. All students must attend the final at the aforementioned time and date.

Homework

Homework will be assigned throughout the course, but it will not be directly graded. In other words, assignments will not be handed in, but you are encouraged to do each assignment as if you will be turning it in. Having such a polished, legible, and completed assignment will aid you in having an extra document to properly study for the course. Each assignment consists of approximately 20-25 problems, and each problem set will be posted on the class webpage. Additionally, each homework assignment will be accompanied by a set of hints, which will be posted some time after the assignment has been posted. I will notify you via e-mail once a new assignment or hint set has been posted.

Quite simply put, your understanding of the topics that will be covered in this class will be directly proportional to the amount of time and effort you put into ACTUALLY studying. Although the homework assignments are not turned in and, thus, are not directly graded, they should be taken VERY seriously. Understanding physics is all about applying your solid knowledge of concepts to do a wide spectrum of problems. The more problems you systematically complete and can undoubtedly claim to understand, and the more you are able to see the connections between homework problems and the represented content, the deeper and richer your comprehension (and the higher your grade) will be.

Laboratory

Experimentation is the ultimate test for the validity of scientific ideas or predictions. A subject cannot be called a science if the concepts in that topic cannot be validated via rigorous experimentation. Thus, a laboratory section is integrated into this course to introduce you to the ways in which physical quantities can be measured. The hope of these laboratories is to show you the validation of, as well as the inherent complexities within, the theory that we will be covering throughout lecture. Furthermore, it will reinforce the difficulties in making measurements and why certain discrepancies between theory and experiment exist. The goal is to incorporate the lab as seamlessly into the lecture as possible, so that the learning process can be a lot more active. You will work in groups to get the experiment done, but *each of you will have to turn in a laboratory worksheet that you complete on your own.*

Labs cannot really be "made up" due to their collaborative nature. Missing more than 2 lab sessions will result in a Laboratory and Participation grade of zero. If you are substantially late to a laboratory session, it will be considered an absence. A lab worksheet that is turned in later than the due date will be penalized, with percentage deductions in proportion to the number of days (relative to the due date) after which the worksheet is submitted to me.

Participation & Class Management

Actively participating in the class will amount to 5% of the total grade. Attendance may be taken at any time during the class, and possibly more than once. However, simply attending class does not guarantee getting the full points allotted for this part of the grade. In other words, class participation is mandatory, whether it be paying attention and taking notes during lecture, actively taking part in group activities (such as labs or worksheet sessions), or being respectful towards your fellow classmates, and me, by not promoting any distractions.

NO CONSUMPTION OF FOOD OR DRINKS (EXCEPT FOR WATER) IS PERMITTED IN THE CLASSROOM. PLEASE DO YOUR CONSUMING OUTSIDE OF THE CLASSROOM ANY TIME BEFORE CLASS, AFTER CLASS, OR DURING THE INTERMISSION(S).

Student Learning Outcomes

When presented with a physical situation and asked to solve a particular problem in, for example, electricity and magnetism (e.g., the creation of an electric current by a changing magnetic field), the student will follow a logical process based on well-established physics principles (i.e., Maxwell's equations) and demonstrate ability to use basic mathematical techniques, including calculus. Furthermore, when conducting a laboratory experiment, the student will demonstrate understanding of the basics of the scientific method by being able to state a clear and testable hypothesis, taking careful measurements, estimating uncertainties, and drawing appropriate conclusions based on gathered data and on sound scientific principles.

Math Help

Although I'm more than happy to help out whenever possible, there are some very good resources available for you to brush up on your math skills. I find that the best resources are on-line video libraries that actually teach you math in a step-by-step fashion, with great examples. They are even self-consistent, as they cover the entirety of various subjects of interest, ranging from basic math, to calculus and beyond. Check them out:

- Patrick JMT
  - Excellent compilation of tutorial-style videos (JMT stands for Just Math Tutorials) aimed to teach mathematics with enough rigor to even cater to a mathematician. Of course, the explanations are unlike those given by a typical mathematician!
- Khan Academy
  - Excellent compilation of videos in the same spirit as Patrick JMT. One nice aspect of the website is that it allows you to practice your learned concepts through exercises that cater and adjust to your level of understanding. Although the practice is not quite perfect, it's still especially good for basic math. The nice thing about Khan Academy is that you could even explore other subjects if you're interested in them, including physics.

Personal Notes

Tentative Schedule (Physics 22, Section 3326)

Week #	*Week Of*	*Topic*	*Comments*
1	Aug 26	Electric Charges Coulomb's Law Electric Forces & Torques The Field Concept Electric ($\vec{E}$) Fields	Mon, Aug 26: First Day of Instruction
2	Sep 2	$\vec{E}$ Fields of Discrete & Continuous Sources $\vec{E}$ Fields Acting on Charges & Dipoles	Mon, Sep 2: Labor Day
3	Sep 9	Electric Flux Gauss's Law & Examples	
4	Sep 16	Electric Potential Electric Potential of Discrete & Continuous Sources	
5	Sep 23	Connection Between Potential and $\vec{E}$ Capacitance & Dielectrics Capacitor Circuits	Fri, Sep 27: Midterm 1
6	Sep 30	Electrostatic Energy Current Resistance & Ohm's Law Resistor Circuits & Kirchhoff's Laws	
7	Oct 7	*RC* Circuits Magnetic ($\vec{B}$) Fields & Sources of $\vec{B}$ fields Right-Hand Rules & Magnetic Forces Biot-Savart Law	
8	Oct 14	Applications of the Biot-Savart Law Magnetic Dipoles & Magnetic Torque Ampere's Law	
9	Oct 21	Magnetic Flux & Gauss's Law Motional EMF Faraday's and Lenz's Laws	Fri, Oct 25: Midterm 2
10	Oct 28	Inductance *LR* & *LC* Circuits	
11	Nov 4	Complex Numbers & Basic Fourier Analysis Basis of AC Circuit Analysis Theory Complex Impedance	
12	Nov 11	Analysis of AC-Circuit Examples The Displacement Current Maxwell's Equations	Mon, Nov 11: Veterans' Day
13	Nov 18	Waves & Their Propagation Electromagnetic Waves The Electromagnetic Spectrum	Fri, Nov 22: Midterm 3
14	Nov 25	Field Energy & Momentum Aether Theory & the Michelson-Morley Experiment	Fri, Nov 29: Thanksgiving Holiday
15	Dec 2	Incompleteness of Galilean Relativity Relativistic Mass, Momentum, & Energy Events & Measurements The Failure of Simultaneity	
16	Dec 9	Length Contraction & Time Dilation	Mon, Dec 9: Last Day of Instruction Fri, Dec 13: Final, 8:00 am - 11:00 am