PHYS 408a: Electricity and Magnetism

Units: 4

Term—Day—Time:

- **Fall 2023**
- **Monday, Wednesday, and Friday from 10.00 am to 11.20 am**
- **Three 80 minutes classes per week, 15 weeks**

Location:

- **In-Person: ZHS 163 (Zumberge Hall)**
- **If needed, the online sessions will be available via Zoom: https://usc.zoom.us/j/97487805161 (check our Blackboard page for the passcode) (remember to sign-in using the SSO method)**

Instructor:

- **Dr. Marcin Abram**
- **e-mail: mjabram@usc.edu**

Teaching Assistant:

- **Chi Xu**
- **e-mail: chixu@usc.edu**

Students Hours (also known as Office Hours):

- **Wednesday, from 3 pm to 4 pm**
- **Online: https://usc.zoom.us/j/8934576028 (check the meeting passcode in the "Contacts" section of the Blackboard page of our class)**
- **Everybody is welcome!**
- **Drop-in, drop-out style: You don't have to make an appointment, just join the session and ask your questions or listen to discussions I have with other students.**

Piazza:

- **https://piazza.com/usc/fall2023/phys408a**
- **To self-sign, use the following code: 5n402h28aqo**

Course Description

Physics 408 is an upper intermediate-level course in physics, that focuses on electrodynamics. In this class, you will study electric and magnetic fields, get practice using advanced mathematical notation, learn how to describe the interaction of electric and magnetic fields with matter, discuss conservation laws, and learn how to derive Maxwell's Equations. In the second semester of this course, you will focus on the implications of Maxwell's Equations, and study in detail how electromagnetic waves interact with matter. We will also talk about radiation, introduce gauge theory (a glimpse into the field theory subject), and discuss relativistic effects (the special theory of relativity and its implications for electrodynamics). If time permits, we will also scratch the surface of the group theory and we will discuss some modern applications of electrodynamics (e.g., in optics).

This class can be seen as the third course in the curriculum of theoretical physics (with the first being Classical Mechanics and the second being Statistical Physics). Nevertheless, while knowledge of classical physics is recommended, familiarity with statistical physics is optional. Physics 408 is your gateway to studying quantum mechanics (PHYS 438), optics, soft matter physics, condensed matter physics, high-energy physics, field theory, and many other specialized classes. The auxiliary goal of this class is to build on ideas from the introductory physics classes while developing a range of new math skills. To achieve this goal, we will make heavy use of concepts from vector algebra, differential calculus, and integral calculus. We will also use some concepts from the field of quantum mechanics (especially in the second semester when discussing optics; However, don't be alarmed, we will introduce or review all the relevant topics during the class, to make sure that nobody is lost).

Learning Objectives

At the end of this course, you will be able to:

1. Describe (quantitatively and qualitatively) the interaction of eclectic and magnetic fields with matter.
2. Discuss and describe the thermal, chemical, and magnetic effects of steady currents.
3. Apply various methods to solve systems consisting of steady and alternating currents.
4. Discuss the microscopic structure of matter and describe its electric and magnetic properties.
5. Motivate the Maxwell's equations and apply them to solve various physics problems.
6. Discuss the conservation laws in the context of electrodynamics.
7. Discuss selected topics from modern physics.
8. Create a scientific visualization featuring selected phenomena from the field of electrodynamics.
9. Prepare peer-review reports.
10. Demonstrate your work in the form of a short academic presentation.

Prerequisite(s)

I have constructed the course with the understanding that you have completed (or you are familiar with the content of):

- ★ Either PHYS 152 (Fundamentals of Physics II) or PHYS 162 (Advanced Principles of Physics II),

Co-Requisite(s) or Concurrent Enrollment

I have constructed the course with the understanding that you have completed (or you are familiar with the content of):

- ★ (for PHYS 408a) MATH 245 (Mathematics of Physics and Engineering I).
- ★ (for PHYS 408b) MATH 445 (Mathematics of Physics and Engineering II).

Recommended Preparation

To succeed with this class, review the information from:

- ★ Introduction to Physics (mostly the sections devoted to electricity and magnetism).
- ★ Classical Physics (PHYS 304), mostly the sections devoted to oscillators, Fourier transform, coupled oscillations, and normal modes.
- ★ Calculus (you should be able to solve simple integrals and multivariable equations).
- ★ Algebra (you should be fluent in matrix calculus; you should know how to calculate eigenvalues and eigenvectors).
- ★ Quantum Mechanics (a general overview)

Course Elements

This course will be comprised of:

- ★ lectures,
- ★ weekly problem sets (short conceptual and longer quantitative questions),
- ★ a student project (discussed below),
- ★ a midterm exam, and
- ★ a final exam.

The course will ordinarily be taken for a letter grade. All information regarding the class will be communicated with you via Blackboard (larger announcements) and Piazza (more informal communication).

Description and Assessment of Assignments

Weekly Problem Sets

Each week (with a few exceptions, see the full schedule on page 14), I will publish a problem set. Those are take-home assignments that in most cases require you to write down solutions to various quantitative physical problems. Each problem set may also contain a few conceptual questions. While answering conceptual questions, you should cite sources that you used. Each problem set will be worth 20 points. There will be 10 problem sets in total. You will all have

approximately 6 days to complete each problem set. The solutions should be uploaded on our Blackboard site in a form of a single pdf file (you can either write the solutions in LaTeX or you can write them by hand, scan the papers, and create a pdf). As long as the problem set is open, you will be able to send multiple answers (only the latest submitted answer will matter). The closing time for the problem set is always the following Friday at 8 am PT (Pacific Time). Specifically,

- ★ The deadline for the *first* problem set is on Friday, September 1, 2023, at 8 am PDT.
- ★ The deadline for the *second* problem set is on Friday, September 8, 2023, at 8 am PDT.
- ★ …
- ★ The deadline for the *tenth* problem set is on Friday, November 17, 2023, at 8 am PST.

You can find the full schedule in the "Course Schedule: A Weekly Breakdown" section on page 15.

Note, that in those written assignments, the completeness and the clarity of your solution (e.g., clarity of your calculations or completeness of your derivations) will matter as much as the correctness of your final answer. Writing down just a single final value (even if correct) is not enough. See the table below:

Grade Component	**Meets Expectations (75%-100%) For Problem Sets: 15-20 points**	**Approaches Expectations (50%-75%) For Problem Sets: 10-15 points**	**Needs Improvement (0%-50%) For Problem Sets: 0-10 points**
Completeness (25%) 5 points in total	All questions are answered. All cases are considered.	Most questions are answered. The most obvious cases are considered (for example non-zero forces are examined, but the student didn't consider a special case when $B < 0$).	The main question is not addressed. The answer is irrelevant to the task. The analysis of the issues and the events are either vague or incomplete.
Clarity (25%) 5 points in total	A non-expert (e.g., a fellow student) can understand the solutions. All concepts and used techniques are defined and explained. Whenever it is applicable, the solution is accompanied by illustrative plots. The plots are explained and interpreted. There are references to sources (and the citation format is correct).	The teacher (or another professional physicist) can understand the solution but a non-expert might have some trouble doing so. The solution has some minor shortcuts or some non-fully self-explanatory assumptions. For example, not every step of the analysis is explained, but it is still possible to follow the author's logic. Some references are missing.	It is hard to follow the solutions. The solution has some major shortcuts or hidden assumptions. There are no references in the texts. The analysis or evaluations of the issues and events are vague. It is either hard or impossible to understand or verify the correctness of the calculations.
Validity (50%) 10 points in total	All calculations are correct. The final values, statements, or plots are correct and the final interpretation or conclusions are plausible.	Small mistakes in the answers and/or calculations (e.g., a wrong sign, a missing constant). The final answer is close to the correct value (e.g., it differs by a small factor - twice too large or twice too small; however, the general trend is correct).	Major mistakes in the calculations and/or in the analysis. The final values and/or conclusions are incorrect or misleading.

Student Project

Your task is to:

- ★ Prepare a scientific visualization in one of the forms described below.
- ★ Peer-review two projects prepared by your colleagues.
- ★ Address the comments that you received from your peers.
- ★ Present your work (4-5 minutes long presentation) in class.

The objective of this assignment is to create a visualization (in one of the forms described below) illustrating a selected physical phenomenon relevant to the study of electrodynamics. In other words, you should create a visual aid that will be useful in a class environment, which can be helpful when explaining some topics belonging to the scope of the PHYS 408 class. You should aim to produce something, that can be used by third parties (either by the instructor of the PHYS 408 class or by the students taking upper-division physics courses themselves). This means, that whatever you produce should be accompanied by a detailed manual explaining how to use it, how to interpret the results, and what learning objectives are practiced.

Projects Realization Form (choose one):

- ❏ *(For those who like Python but are not CS majors)* Create an interactive Jupyter notebook, where you would include some interactive plots, illustrating the results of a scientific simulation of the interesting phenomenon. The notebook should include a description of the relevant physics and instructions on how to run the simulation. Publish the notebook on GitHub or another similar hosting platform.
- ❏ *(For those who have an engineering background)* The same as above, but use MatLab (this software is available for free to USC students, see https://software.usc.edu/matlab/).
- ❏ *(For those who do not like programming and/or are more mathematically oriented)* The same as above, but use Wolfram Mathematica (this software is available for free to USC students, see https://software.usc.edu/mathematica/).
- ❏ *(For those who really like programming)* Create an interactive scientific simulation. Allow users to insert parameters of the simulations and/or the angle of the camera, and demonstrate the physics of chosen phenomena. As the deliverable, publish both the source code and the executive file. In the accompanied documentation, explain also how to run the simulation.
- ❏ *(For those who would like to check how it is to be a game designer)* Create a computer game illustrating a chosen electrodynamic phenomenon. The game should be scientifically correct as much as possible[1] but still playable. Preferably, you should host the game in a web location accessible to other people (for example on itch.io or on another similar hosting platform).
- ❏ *(For those who prefer more traditional forms of science communication)* Create a larger-format poster that includes both the description and plots illustrating the physics of

[1] The game should belong ot the "serious game" genre, see https://en.wikipedia.org/wiki/Serious_game.

some related phenomena relevant to the study of electrodynamics. If you are choosing this form of scientific communication, I would encourage you to try the LaTeX/Beamer template that I created for you: https://www.overleaf.com/read/sxqmttnwjmft.

- ❏ *(For those who like traditional media forms of communication)* Create an educational video or animation. The video should contain either simulations, demonstrations, or another type of visualization, illustrating the relevant physics phenomena of your choice, relevant to the topics of the class.
- ❏ *(For those who like experimental physics)* Design (and if possible, conduct) an experiment, that illustrates a chosen phenomenon. Preferably, the experiment should be possible to conduct in a class environment. If the setup of the experiment is too difficult to conduct in the class (you need special equipment and/or it would take too much time), you might attempt to record a video demonstration or create a poster with a detailed description of the experiment. As an example, you can build a coilgun (an electromagnetic railgun cannon, aka. Gauss canon). Or demonstrate the physics of a tunnel diode. Or demonstrate the dielectric anisotropy of nematic liquid crystals (just don't burn yourself). Or show the Kerr effect of polar liquids (just don't electrocute yourself). To make sure you will stay safe, after all, you might deal with electricity or high temperatures, if you attempt to conduct any experiment, consult your choice and the details of the experimental setup with me.
- ❏ *(For those who have a more art or design-rich spirit)* Unleash your creativity. Chose any other, less-traditional form of scientific communication. You can paint. You can create a sculpture. You can design a board game that helps the players learn relevant physics. Since there are infinite possibilities here, please consult your choice with me.

Projects Objectives:

- ❏ First and foremost, the topic of your project should be relevant to the class. It should describe something related to the study of electrodynamics.
- ❏ The project should be something that goes beyond the scope of simple systems described in the class. For example, visualization of the magnetic field around a single, infinitely long wire with a steady current is too simple - it is something included in every textbook. A simulation illustrating the tunneling of evanescent waves or visualization of the light propagation through different biaxial and uniaxial crystals (with an explanation of the physics and description of some applications) would be appropriate.
- ❏ I am not going to suggest any particular topics. One of the objectives of this course is for you to define your own topic and choose an appropriate form of presentation.

The structure and the formatting of the accompanying documentation:

Whatever you produce, should have accompanying documentation. Remember that the target audience consists of other people, either in your current class or those who will take PHYS 408 in the future. When completing the project, think that the target audience might interact with the

visualization without you being around to show or guide them. Therefore, depending on the form of your project, different documentation may be required:

- ❏ If you produced a scientific simulation, and the code is presented in a public GitHub repository, use markdowns to describe how to start the code, what are the hardware requirements, and code dependencies, explain how to control the simulation, show the output examples, explain how to interpret the results.
- ❏ If you developed a game, record a tutorial or describe how to play the game, what is the objective, and how to interpret what you see on the screen.
- ❏ If you recorded a video or created a poster - those forms might be a bit more self-explanatory - nevertheless, even in those situations you should have a short description of what the video or the poster presents (imagine a student, looking at the collection of all the projects - help them navigate; it is easier to read the descriptions of the project than to reading or watching the presentation only to find, that it covers a different topic).
- ❏ If you are uncertain what form of documentation would be the best, consult with me.

Detail description of steps:

1. Prepare and share your work plan by **Tuesday[2], September 5, by 8 am PDT**. You don't have to know your topic yet. However, you should have a plan for how long your "exploration" phase should last. The plan should include answers to the following questions: When you should have your topic ready, when you should start creating your visualization, etc. Make sure that your plan is consistent with all the deadlines described in this syllabus.
2. Choose your topic and the preferred form of visualization.
3. Find relevant literature. Read about your topic. Prepare a literature review **by Monday, September 18, by 8 am PDT**.
4. Make a detailed outline of your project. Describe what you will visualize, what type of visualization you will make, and how you will proceed with the realization of it. Submit your project outline **by Monday, October 2, by 8 am PDT**.
5. Complete the necessary calculations and/or simulations. Prepare the first plots and figures (if relevant).
6. Prepare the first, rudimental version of your visualization. You should have an early version by October 23 (the two-month mark after the start of the classes). You do not have to upload it yet - it is your internal deadline.
7. Polish your design. Prepare the documentation. Always remember to cite your sources. Remember, that a simple list of references at the end of your documentation is not enough - your sources must be cited in the main text of your documentation (similar to how it is done in any scientific text).

[2] As you can see, every other deadline is on Monday. The reason why the first deadline is on Tuesday is that Monday, September 4 is a national holiday.

8. Deploy an early version of your project. Submit the link to your project via Blackboard **by Monday, October 30, not later than 8 am PDT**.
9. Choose two projects prepared by your peers (I will coordinate this process, to make sure that each project gets an equal number of reviewers). Read the documentation and check whether you understand the visualization. Using the Blackboard forum, give each author suggestions on how they can improve their work (you can also assess, whether everything is accessible and understandable - the problem with visualizations is that sometimes they look impressive, but they are incomprehensible to anybody but to the authors - you should be able to understand the visualization by only interacting with it and by reading the documentation - if it is not, describe your experience and suggest improvements). You should complete this action **by Monday, November 13, by 8 am PST (note the change of the time from PDT to PST)**.
10. Read the suggestions you received from your peers. Address them (either incorporate the suggested changes or challenge them, by describing in a separate post why you think those changes would not improve the quality of your documentation/visualization).
11. Submit your final project **by Monday, November 27, by 8 am PST**.
12. Present a short summary of your work (4-5 minutes) **either on Monday, November 27, or Wednesday, November 29, or Friday, December 1**.
13. Write an academic reflection, summarizing your experience. Submit it **by Monday, December 4, by 8 am PST**.

Additional Notes:

You are free to use any sources. However, you must cite all sources that you used (if not, you will violate the academic integrity standards). It might happen that you will cite non-peer-reviewed sources, like technical documentation of certain libraries or technical blog posts. This is acceptable as long as the non-peer-reviewed sources do not constitute the majority of your bibliography. If you decided to use quotes, remember to use them correctly.

If you happened to use text (or images) generated using machine learning generative methods, you should treat it as a citation from a non-peer-reviewed source (you must disclose it, and you should clearly mark sections where you used the generated text of images). The same applies if you generated a text (or images) and then adapted them (modified). You should disclose that practice and clearly mark, where the adapted text (or images) is present, and cite the source (e.g., the particular model and version of the generative system). The same would be expected if you adapted (copy with some modifications) text from a book or illustration from somebody else's article (assuming, that the license of the source permits this). In such a case, you would be also expected to disclose it and properly cite the original author. Not doing this is seen as stealing intellectual property.

Remember, that plagiarism (this includes using sources without proper citations) is a major violation of the university's academic integrity standards and will be reported to the Office of Student Judicial Affairs and Community Standards at USC. You can read more about this in

https://policy.usc.edu/wp-content/uploads/2023/03/USC_StudentCode_February2023.pdf - you should also review Appendix A: Academic Dishonesty Sanction Guidelines.

Finally, when you create your visualization, think about your audience. Your main audience is not the instructor, it is your peers. Write in a way that your colleagues can understand. You can assume certain fluency in math and physics in your readers but do not assume that your audience has any specific prior familiarity with the topic of your project.

Project Grading Criteria:

Grade Component	Meets Expectations (90%-100%)	Approaches Expectations (75%-90%)	Needs Improvement (50%-75%)	Inadequate (0%-50%)
Content	The content matches the topic. The overall quality of the work is high. The topic is challenging. The analysis and the discussion are comprehensive.	The content matches the topic. The overall quality of the work is high - however, there are some minor problems. For example, the discussion part doesn't cover all the important aspects.	The content matches the topic. However, there are some major issues. For example, the analysis, and the discussion are not comprehensive.	The content does not match the topic; There are major factual mistakes. We detected that *any* part of the project or documentation was not written independently (e.g., plagiarism).
Support	All claims are supported by relevant citations. Citations are high quality (mostly peer-reviewed sources).	All claims are supported by relevant citations. Citations are low quality (mostly non-peer-reviewed sources).	Not all claims are supported. Citations are low quality (mostly non-peer-reviewed sources).	No citations (note, a simple list of references at the end is not enough)
Clarity	The reader can understand everything without any problem.	There might be a few moments or a few aspects of the visualization where the reader might have trouble understanding all the details.	There might be several parts of the visualization that might be unclear to the reader.	The reader might have trouble understanding what the visualization is about.
Organization	The organization of the visualization makes sense given the topic.	Minor problems with the organization of the visualization.	Problems with the organization of the visualization might affect the ability of the reader to understand the work (e.g., the reader might feel like parts of the visualization are not connected, or that the flow of the information is abrupt or chaotic).	Not all key elements of visualization are present.
Format and Style	The format and style match the major journal's guidelines. In other words: the end product looks like an academic visualization.	Minor problems with the style and the format.	Major problems with the style and the format.	The format and style of the visualization violate the journal's guidelines.

Mid-Term Exam

You will be asked to solve similar problems as those that are included in the weekly problem sets. The official date for our mid-term exam is Friday, October 20 from 10 am to 11.20 am PDT (we will write it in our classroom, during our regular Friday session).

Final Exam

You will be asked to solve similar problems as those that are included in the weekly problem sets. The official date for our exam is Monday, December 11 from 8 am to 10 am, see also the official schedule at https://classes.usc.edu/term-20231/finals/.

Technological Proficiency and Hardware/Software Required

Technological proficiency can be helpful but is not required. Note, that while some students' projects might require a basic knowledge of a programming language (it could be one of many: R, Python, Julia, Java, or C++) or basic proficiency in some mathematical software (e.g., Mathematica, MATLAB), you can always choose a project that requires less or no programming skills.

Required Readings and Supplementary Materials

For the most part, we are going to follow "Introduction to Electrodynamics" by David J. Griffiths. There are also additional textbooks that you can download free of charge from the USC libraries, https://libraries.usc.edu/, that you might find helpful, for example:

- ★ Andrew Zangwill, "Modern Electrodynamics" (Cambridge University Press),
- ★ Kjell Prytz, "Electrodynamics: The Field-Free Approach. Electrostatics, Magnetism, Induction, Relativity and Field Theory" (Springer International Publishing),

and many others (just type "Electrodynamics" or "electromagnetism" and see the results).

Grading Breakdown

Course Element	Points
Weekly Problem Sets (9 out of 10)	180 (=20x9)
Work Plan	5
Literature Review	10
Project Outline	10
Project Draft	10
Peer Reviews	20
Student Project	60
Academic Reflection	5
Midterm Exam	40
Final Exam	60
TOTAL	**400**

Grading Scale

Course final grades will be determined using the following scale.

Final Grade	% of Total Points	Number of Total Points (rounded down)
A	[92% - 100%]	368-400
A-	[89% - 92%)	356-367.9
B+	[86% - 89%)	344-355.9
B	[81% - 86%)	324-343.9
B-	[78% - 81%)	312-323.9
C+	[75% - 78%)	300-311.9
C	[70% - 75%)	280-299.9
C-	[67% - 70%)	268-279.9
D+	[64% - 67%)	256-267.9
D	[59% - 64%)	236-255.9
D-	[55% - 59%)	220-235.9
F	[0% - 55%)	0-219.9

Assignment Submission Policy

Late solutions to problem-set solutions will not be accepted. The reason is that just after the deadline (during the following lecture) we will all discuss the correct solutions - thus if you sent me late work, I won't be able to determine whether your solution is original or not.

Because unforeseen situations might happen to anybody, when calculating the final score I will drop one problem set with the lowest score. This means, that you can forget to submit, be late, or purposely omit one problem set (nominally worth 20 points) and still be able to collect up to 400 points (100%) and receive an A.

Make-up Policy and Additional Points

There are only two ways to earn additional points (not included in the grading breakdown above). The first is the Piazza activity (answering other students' questions, sharing helpful notes, etc.; +3 points in total, awarded at the end of the semester). The second is the in-class activity (presenting problem solutions during our Friday session; +1 point per solution [limit to 1 point per week per person]). There will be no other make-up exams, tasks, or problem sets. If you are late or if you fail to submit your work, you will not receive any points. Therefore, I encourage you to submit all your work as early as possible (to avoid last-minute internet issues), and always check whether you submitted the right file (it happened a few times in my past classes that a student submitted homework solutions from another class - in every case the mistake was caused by the fact the files had some generic names, e.g. "homework5.pdf" - therefore, please be extra cheerful when submitting solutions - always check what you submitted).

Grading Timeline

We will make every effort to grade and return homework within 10 days after it is received. Homework solutions will be discussed during the lectures. If you need more clarification, you can always ask me either during the lecture or during our weekly student hours (office hours).

Academic Honesty and the Need for Proper Citations

You will get an individual grade at the end of this course, thus you shall write answers to any assignments individually as well. As long as the submission period for the problem set is open, you shall not share your solutions. Specifically, on Piazza, before the deadline is due, you are forbidden to explicitly discuss the solutions to the problems. However, if you see that somebody is stuck, you can help your colleague by giving them some hints, explaining the concept your colleague struggles with, or suggesting a helpful resource (this can at the end of the semester, give you a few extra points). If you are uncertain whether a particular hint or help is allowed, ask and we will be happy to assess the situation for you.

If you happened to find a solution to one of the homework problems in a textbook, on the internet, or with the help of another resource[3], you are obligated to acknowledge this by providing a proper citation. You should also clearly indicate which portion of your solution was inspired by those sources (or people) and what your individual contribution is. I acknowledge that it is hard to unseen things that you have seen, so if you happened to find a similar problem with a solution, you should not pretend that it didn't happen, just acknowledge the source. I will never punish honest behavior. However, if we find that you copied a part of your solution without providing an appropriate acknowledgment or citation, we will see this as a violation of academic integrity. Note, that using sources without proper citations is a form of plagiarism and as such, it is a major violation of the university's academic integrity standards.

The Official Position of USC Regarding Academic Integrity[4]

"The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the USC Student Handbook. All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from

[3] Including AI generative services or systems, like ChatGPT, Bard, Bing Chat, Jasper.ai, Claude, Perplexity, Vicuna, LLaMA, or any other locally run or cloud-based generative chat system.

[4] The following 5 paragraphs must be included in each syllabus, see the official USC Syllabus template at https://cet.usc.edu/teaching-resources/syllabus-template/

the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the student handbook or the Office of Academic Integrity's website, and university policies on Research and Scholarship Misconduct."

Additional Policies

Names, Gender:

If you have a name and/or pronouns that differ from those in your official USC records, please let me know.

If I am mispronouncing your name, please correct me. I am highly empathetic on this point because my given name (Marcin) is pronounced [ˈmart͡ɕin] using the International Phonetic Alphabet and is often mispronounced in the US.

Mental Health:

If you feel that experiences outside of class are impacting your course performance, please come and talk to me. If you would rather consult someone outside the classroom, you might contact the USC Counseling and Mental Health Services (https://sites.usc.edu/counselingandmentalhealth/) or Student Counseling Services (SCS), (213) 740-7711 – 24/7 on-call.

Faculty Liaisons:

All classes in the Department of Physics & Astronomy have an assigned Faculty Liaison (previously called "Course Ombudsman") to serve students as a confidential, neutral, informal, and independent resource when they wish to discuss issues concerning their course without directly confronting their instructor. The Faculty Liaison for this class is Prof. Jack Feinberg, e-mail: feinberg@usc.edu, phone 213-740-1134. You can also find him in SSC 327 (room 327 in the Seaver Science Center).

Equity and Diversity and Title IX:

The Office of Equity and Diversity (OED) and the USC Title IX Office work with faculty, staff, visitors, applicants, and students around issues of protected classes: https://eeotix.usc.edu/. Incidents of bias, hate crimes, and microaggressions can be confidentially reported to Student Life: https://studentaffairs.usc.edu.

Accommodations:

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. If you have registered accommodations with the Disability Services and Programs Office (https://osas.usc.edu/), please communicate those to me at your earliest convenience so we can discuss your needs in this course. For those on or near campus, DSP is located in STU 301 and is open from 8.30 am to 5.00 pm, Monday through Friday. They can be contacted online or by phone at (213) 740-0776 (Phone) or via email, OSASFrontDesk@usc.edu.

Statement for observance of religious holidays

USC's policy grants students excused absences from class to observe religious holidays: http://orl.usc.edu/life/calendar/absences/. In this case, please contact your instructor in advance (at least a week in advance) to agree on alternative course requirements.

Hybrid Classroom Policies

The official recommendation of the university is that we should have classes in person. By default, the classes will not be recorded unless I'm aware that some students are prevented from attending the class by some unavoidable factors[5]. While I am obliged to follow the official recommendation, we should still be mindful of our own health and the health of other people. If you are sick and you think your physical presence could put you or others at risk (e.g., you could expose them to a virus you struggle with), inform me and I will provide you a Zoom link to our class.

Special Accommodations

If you need any special accommodations, tell me. If you are in a situation that prevents you from attending the lectures (either in person or remotely), e.g., the time of the lectures collides with your work or with other obligations (e.g., you are a primary caregiver for a child, elderly parents, or other dependants), please let me know as well. I will work with you to find a suitable arrangement that is fair to both you and other students.

[5] One such factor can be the threat of Hurricane Hilary, scheduled to hit Los Angeles on August 20. Therefore, the first lecture on August 21 will be recorded.

Course Schedule: A Weekly Breakdown

	Topics	Readings	Deliverables
Week 1 August 21 August 23 August 25	Introduction, mathematical background revision, differential and integral calculus, Dirac delta function, vector fields, Helmholtz theorem.	Griffiths, Chapter 1	--- ---
Week 2 August 28 August 30 September 1	Introduction to electrostatics. Coulomb's law, Gauss's law, Poisson's equation, and its special case for ρ=0.	Griffiths, Chapter 2	Problem Set 1 (September 1)
Week 3 --- September 6 September 8	Laplace's equation and the uniqueness theorems.	Griffiths, Chapter 3	Work Plan (September 5) Problem Set 2 (September 8)
Week 4 September 11 September 13 September 15	Methods of solving Laplace's equations. The method of images, separation of variables, and multipole expansion.	Griffiths, Chapter 3	Problem Set 3 (September 15)
Week 5 September 18 September 20 September 22	Electric fields in matter. Dielectrics, dipoles, polarization, susceptibility.	Griffiths, Chapter 4	Literature Review (September 18) Problem Set 4 (September 22)
Week 6 September 25 September 27 September 29	Introduction to magnetostatics. The Lorentz force law, the Biot-Savart law, and the Ampère's law.	Griffiths, Chapter 5	Problem Set 5 (September 29)
Week 7 October 2 October 4 October 6	Solving problems from the magnetostatics. *(Midterm Grading Period begins)*	Griffiths, Chapter 6	Project Outline (October 2) Problem Set 6 (October 6)
Week 8 October 9 October 11 ---	Magnetic fields in matter. Diamagnets, paramagnets, and ferromagnets.		(Nothing - so you have a small break)
Week 9 October 16 October 18 October 20	Buffer week.		**Midterm** **(October 20)**
Week 10 October 23 October 25 October 27	Introduction to electrodynamics. Ohm's law, Faraday's law, and problems with Ampère's law.		Problem Set 7 (October 27)
Week 11 October 30 November 1 November 3	Putting everything together: Maxwell's Equations. *(Midterm Grading Period ends)*	Griffiths, Chapter 7	Project Draft (October 30) Problem Set 8 (November 3)
Week 12 November 6 November 8 ---	Working with Maxwell's Equations.	Griffiths, Chapter 7	Problem Set 9 (November 13)[6]

[6] November 10 is a national holiday. Therefore, the deadline is pushed to the next instructional day (November 13).

Week 13 November 13 November 15 November 17	Discussion of conservation laws.	Griffiths, Chapter 8	Peer Review Reports (November 13) Problem Set 10 (November 17)
Week 14 November 20 --- ---	Buffer week or a special topic.	TBA	(Nothing - so you have a small break)
Week 15 November 27 November 29 December 1	Final project presentations.		Project Submission (November 27) Final Presentations (Nov 27 - Dec 1)
Final Exam December 11	Official Examination Day is Monday, December 11, from 8 a.m. to 10 a.m. *(Final Grading Period ends on December 19)*		Academic Reflection (December 4) **Final Exam (December 11)**

Note that the plan of the topics (especially the order) is provisional and can be modified during the semester. This plan should aid us, but should not restrict us. If I notice that another order (or another topic) would work better for you, I will adjust the plan of topics accordingly.

Student Hours (also known as Office Hours)

I will host one 60-minute meeting per week. Those Student Hours (also known as Office Hours) are a dedicated time when you can come to ask questions and resolve confusion about course material, as well as discuss career and educational goals as they relate to this course.

No special appointment is needed, however, if you sent me an email or post a question on Piazza a day earlier, announcing a type of question you have, I might be able to prepare a better answer for you in advance. If you have any sensitive questions, you can also contact me via mail, mjabram@usc.edu and we can schedule a 1-on-1 meeting via Zoom outside the student hours period. You can also always chat with me after the class.

Improving the Syllabus

If you noticed any typos or mistakes in the syllabus, or if you find any part confusing or unclear, please let me know (either in class, after class, during office hours, writing on Piazza, or via e-mail). I put a great deal of effort into proofreading everything, but typos and omissions are still possible, therefore I would appreciate your feedback.

When approaching this syllabus, we should follow the spirit of the law, not the letter of the law - meaning, a typo or clumsy wording should not be an excuse to create any loopholes if otherwise, the general intent of the document is easy to infer. Nevertheless, I don't want to have any students confused about what is expected from them - so if you find any ways to improve this syllabus, please tell me.

Support Systems

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

988 Suicide and Crisis Lifeline - 988 for both calls and text messages – 24/7 on call
The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL) – 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 740-0411
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call
Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-2850 or otfp@med.usc.edu
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.