PHYS 305 - Electromagnetic Theory

- Day and Time: Tuesday/Thursday from 12:00 pm - 1:15 pm (on Zoom)
- Office Hours: Tuesday/Thursday from 11:00 am – noon (on Zoom)
- Discord URL: See email
- Instructor: Bob Weigel
- Email: rweigel@gmu.edu
- Office: 259 Planetary Hall
- Course URL: http://rweigel.github.io/phys305/

1 Topics Covered and Catalog Description

This course covers the topics in Chapters 1-7 of the textbook.

The catalog description is

> Physics 305 Electromagnetic Theory
>
> Interaction of static charges, interaction of stationary currents, electromagnetic induction, and Maxwell's equations.
>
> Required Prerequisites: PHYS 260^C and PHYS 301*.
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> ^{C} Requires minimum grade of C.
>
> * May be taken concurrently.

2 Format of Course

The delivery of this course is centered on tutorials that introduce topics, provide examples, and require you to solve problems related to the examples. In general, I will not have a formal lecture prepared.

1. Most of what I would normally lecture on has been written into the tutorials and their examples.
2. I have done this to maximize the amount of time available for students to ask question during class.
3. **If you do not work on the tutorial before class, you will not find class attendance helpful.**

3 Discord

The first week of class, you should have received an email inviting you to join a Discord server. I will use Discord to answer questions.

4 Succeeding in this Course

For many, this may be your first junior/senior-level physics course. To succeed, you may need to change the way you study. In addition to what is written below, please see Joe Weingartner's

PHYS 303 syllabus for his perspective and Feynman's Never forget an idea again.

Success in this course depends primarily on two factors, in order of importance:

1. How many problems you solved "the right way" (I will discuss this in class)
2. How much you discussed problems and concepts with others

> It is easy to find solved physics problems. Reading their solution before thinking about them is about as useful as learning to play basketball by watching a video. If you aren't confident that you can solve a problem, attempt to solve it without the use of the solution and compare your solution with a classmate's *before* looking at the solution.

How to read:

- Read an explanation of a topic and fill in the missing steps.
- Close the book or web page and attempt to repeat the explanation. Check your answer. If you got it wrong, re-visit the problem a day later.
- If you are successful, attempt to re-solve the problem differently (for example, using a different coordinate system or using Gauss' Law instead of Coulomb's law, etc.). Check answer. If you got it wrong, re-visit problem a day later. Keep a separate notebook with a list of things you had issues with and how you resolved them.

5 Grading

Your grade for this course has two components:

1. Homework average (30%) - approximately one per week
2. Exam average (70%) - one midterm and one final, equally weighted

Because of the size of this class, I may not grade all problems on every homework assignment. You score is based only on the problems selected for grading.

There will be two exams during the semester and a cumulative final exam. The exams carry equal weight.

The midterm will cover Chapters 1-3 of Griffiths

The final exam will cover Chapters 4-6 of Griffiths

The nominal percentage-to-letter grade conversion is (this is subject to change such that the required percentage score for a given letter grade is lower)

- > 97: A+; 93 to $96.\overline{9}$: A-; 90 to $92.\overline{9}$: A-
- 87 to $89.\overline{9}$: B+; 83 to $86.\overline{9}$: B; 80 to $82.\overline{9}$: B-
- 77 to $79.\overline{9}$: C+; 73 to $76.\overline{9}$: C; 70 to $72.\overline{9}$: C-;
- 60 to $69.\overline{9}$: D
- < 60: F

6 Textbook

I will follow the outline of the topics covered in chapters 1-6 (and 7, if time) in Introduction to Electrodynamics (4th Edition) by David J. Griffiths. Note that the 3rd Edition is also widely available. You may buy either edition. However, I will reference pages and problem numbers from 4th edition.

7 Suggested References

The following references may be used as additional study aids. They have been listed in order of importance/usefulness.

Electricity and Magnetism (3rd Edition) by Edward M. Purcell and David J. Morin covers the same topics as Griffiths at the same level. If you are looking for an alternative explanation, this textbook will be helpful. The book contains far more examples, discussion, and content than Griffiths. It also includes solutions.

Schaum's outline of theory and problems of electromagnetics by Joseph A. Edminister is a great reference for problems with full solutions and summaries of topics.

Div, Grad, Curl, and All That: An Informal Text on Vector Calculus (4th Edition) by H. M. Schey is an excellent reference for the mathematical background that you need to understand for this course. The book contains a concise and clear review of topics that are covered in a vector calculus course (usually "Calculus III").

A Student's Guide to Maxwell's Equations (1st Edition) by Daniel Fleisch notes that "the focus is exclusively on Maxwell's Equations, which means you won't have to wade through hundreds of pages of related topics to get to the essential concepts. This leaves room for in-depth explanations of the most relevant features, such as the difference between charge-based and induced electric fields, the physical meaning of divergence and curl, and the usefulness of both the integral and differential forms of each equation." A web page with detailed solutions to problems is available at http://www.danfleisch.com/maxwell/.

The Feynman Lectures on Physics: Mainly Electromagnetism and Matter, Volume 2, 1977 contains excellent lecture-style presentations on Electricity and Magnetism. The full volume is available online.

Yale Lectures on Physics II is a lecture series on topics typically covered in a second-semester physics course and does not cover the mathematics at the level required for this course. These videos may be useful as a review.

8.07 Class Notes by John Belcher covers the same topics as Griffiths and has additional examples.

Other links:

- Finding E-Books at Mason

8 Important Dates

Important Dates from Registrar

No class:

- Tuesday, October 15th (Monday classes/labs meet Tuesday. Tuesday classes do not meet this week)
- Thursday, November 28th (Thanksgiving)

Final Exam: Thursday, December 12th 10:30 am - 1:15 pm (Final Exam Schedule). Location and deliver method TBD.

Last class: Thursday, December 5th

9 University Policy

University Policies: http://universitypolicy.gmu.edu/

10 Disability Accommodations

If you have a learning disability or other condition that may affect academic performance, please: a) make sure documentation is on file with Office of Disability Services (http://ods.gmu.edu) to determine the accommodations you need; and b) talk with me to discuss your accommodation needs.

11 Counseling and Student Support

- Counseling and Psychological Services provides confidential psychological services, including 24/7 crisis intervention and consultation to faculty and staff: http://caps.gmu.edu/
- Student Support helps students negotiate life situations by connecting them with appropriate on- and off-campus resources : http://studentsupport.gmu.edu/referral-form/