

# Physics 7410: Electricity & Magnetism I (Fall 2021)

Kent Yagi

## 1 Basics

Instructor: Kent Yagi  
Office: Physics 318  
Lectures: 9:30–10:45am Tuesdays & Thursdays, Physics room 210  
Office hours: Mondays 2:30–3:30pm (in-person, appointment only)  
Mondays 3:30–5:00pm (online)  
(You are welcome to ask me questions via email at any time.)  
Phone: 982-2329  
e-mail: ky5t@virginia.edu  
Grader: Sid Ajith (sa4fb@virginia.edu)

Class Web Page: UVA Collab *21F PHYS 7410*

## 2 Textbooks

I will be mainly following

- J. D. Jackson, *Classical Electrodynamics*

Other Good Reference Books:

- Griffiths, *Introduction to Electrodynamics*
- Garg, *Classical Electromagnetism in a Nutshell*

## 3 Grade weighting

Grade will be determined with the following weighting and *on curves* :

35% Homework  
20% Midterm exam  
45% Final exam

## 4 Lectures and Attendance

You are responsible for the material presented in class, turning in your homework on time, knowing problem assignments, and knowing any administrative announcements made, such as changes to the syllabus or changes to the scheduling of homework or exams.

## 5 Office Hours

Office hours will be held on Mondays at 2:30-5pm. At 2:30–3:30pm, it will be held in-person in my office. To keep the density minimal, **please send me an email to make an appointment beforehand**. At 3:30–5pm, the office hour will be held online via Zoom (access information to be announced separately).

## 6 Homework

Homework will be assigned almost every week, starting from Aug. 31. Problems will be uploaded under “Assignments” in Collab website. You may submit your answers either by bringing them to the classroom or submitting them electronically through “Assignments” in Collab. Answers will be uploaded under “Resources” in the same website. Late homework submission will be assessed a penalty, which will grow as time increases.

Discussing the problems with each other is encouraged, but I expect each individual to write up their own solutions without direct copying. Copying another person’s solution that you did not substantially participate in is unacceptable. In a limited number of occasions, you may ask for an extension of due dates in advance provided you have good reasons to do so.

You may be able to find some of the solutions from students who have taken this course before. **DO NOT** obtain or look at solution sets from previous years. The primary purpose of assigning these problems is for you to **struggle and learn**. Also, don’t just write down answers, **show derivations!**

Mid-term and final exams will contain problems that are very similar to homework problems, so take the latter seriously and make sure that you can solve them on your own.

## 7 Exams

Exams to be held in the normal classroom.

MID-TERM EXAM, Thursday, October 14, 9:30 a.m. – 10:45 a.m.

FINAL EXAM, Tuesday, December 14, 2:00 p.m. – 5:00 p.m.

## 8 Topics

We will study Chapters 1–6 of Jackson, as well as some mathematical preliminaries, including **(but not limited to)**

### 1. Mathematical Preliminaries

- Vector Analysis
- Fourier Transform
- Helmholtz Theorem

### 2. Electrostatics

- Coulomb's Law
- Gauss' Law
- Scalar Potential
- Poisson and Laplace Equations
- Green's Theorem
- Boundary Conditions
- Method of Images
- Orthogonal Functions and Expansions
- Fourier Series and Integrals
- Separation of Variables
- Two-dimensional Potential Problem
- Legendre Polynomials
- Spherical Harmonics
- Bessel Functions
- Multipole Expansion
- Dielectric Media and Polarizability

### 3. Magnetostatics and Magnetodynamics

- Biot and Savart Law
- Ampère's Law
- Vector Potential
- Multipole Expansion
- Magnetization
- Boundary Value Problems
- Magnetic Scalar Potential

- Magnetic Shielding
- Magnetic Induction

#### 4. Maxwell's Equations and Conservation Laws

- Maxwell's Equations
- Gauge Transformations
- Wave Equations and Retarded Solutions
- Macroscopic Electromagnetism
- Poynting Theorem
- Retarded Green Function