



PHY 12: Electricity and Magnetism

Basic Information

Instructor Name	Helmut Vogel
Home Institution	Carnegie Mellon University

Course Description

This is the second in a sequence of two introductory physics courses. The subject matters are Electricity and Magnetism (text, chapters 21-32). First, we introduce the physical laws that relate electric fields, magnetic fields, charges and currents. Then, the combined topics will be used to discuss electrodynamics and electromagnetic waves. Acquiring an understanding of the electromagnetic force and how it can be harnessed it is one of the greatest achievements of humankind. This achievement has led to an incredible technological revolution that continues unabated to this day.

While there are no formal prerequisites to this course, in order to do well in it you MUST be familiar with (1) basic concepts of mechanics such as conservation of energy and momentum, and (2) basic differential and integral calculus, as well as vector concepts and vector calculations.

Textbook

University Physics, 14th ed, H. D. Young & R. A. Freedman, Vol. 2, Pearson, 2014

Assignments

The list at the end of this syllabus gives general reading assignments for each week. The weekly problem assignments you will receive indicate the *minimum* level of achievement expected. The working of the assignments is the single most important tool to learning the course material. **In addition, there will be two 2-hour lab sessions where, under supervision by expert BJTU staff you will perform and analyze experiments on selected topics in electromagnetism using state-of-the-art laboratory equipment.**



Homework, Quizzes/Exams, and Grading

There will be 2 homework assignments due each week. You should write them up legibly and understandably. A selected subset of the problems will be graded. You are encouraged to discuss general problem-solving methods with other students, but the solutions you hand in must be uniquely your own. Copying solutions from fellow students or from other external sources constitutes cheating.

In addition, there will be at least one in-class test each week, plus a final exam on the last day of classes. No calculators, open books, notes, or other reference materials, nor communication among students will be allowed on these tests. Formula sheets will be provided where appropriate.

Your course grade will be based on the in-class tests (40%), the homeworks (20%), the Lab reports (10%), attendance (5%), and the final exam (25%). Grades for the course will be assigned on an absolute scale, with the following approximate cutoffs: A(>87%), B(75-87%), C(60-75%), D(50-60%), F(<50%). Grading will not be done on a curve, so you are only in competition with yourself, and helping other students will not hurt you! In borderline cases I will put emphasis on additional factors such as attendance and participation in class, consistency of performance, and improvement over the course of the four weeks.

How to Study in This Course

Learning is a collaborative activity involving you, your fellow students, and the staff. Treating each other with mutual courtesy and respect is important to develop the environment we need for a successful experience. You are encouraged to collaborate with other students while thinking about how to solve problems, since talking (and, yes, arguing!) about physics is one of the best ways to learn physics. Of course you need to write down solutions to problems on your own, since this is the way to solidify your understanding and to develop the analytical skills you need.

Attendance in class is very important; experience shows that active participation in



the classes leads to better performance. Come to class prepared! This means read the chapters ahead of time, and look over and try to solve the assigned problems. The purpose of the lectures *is* to: inspire you, explain the tougher issues in the book, make you think rigorously about what is going on, stimulate you to go off and learn the material yourself, and show you some demonstrations to illustrate the physics you are learning. The purpose of the lectures *is not* to: introduce you to new material, cover everything you are expected to learn, or dwell entirely on problem solving.

Use of electronic devices in class

- Your mobile phone must be on silent at all times.
- You may open your laptop, with the sound turned off, to take notes but not for any other purpose, so that the screen does not distract you or other students nearby.
- Audio- or video-recording of any class activity is not permitted except with prior written consent of the instructor. Even then the recordings may not be used for any purpose other than personal and educational.

Course Outline

Please note that this schedule is approximate and subject to modification as we establish a suitable pace of the course. Thorough understanding of subjects in physics is more important than rushing through a large amount of material superficially.

Week 1: Electrostatics

Chapter 21: Electric Charge and Electric Field

Ch.22: Gauss' Law

Ch.23: Electric Potential and Potential Energy

Ch.24: Capacitance and Dielectrics

Week 2: Electrical Currents and Circuits; Magnetism

Ch.25: Current, Resistance, Electromotive Force; Motors

Ch.26: DC Circuits; RC Circuits

Ch.27: Magnetic Field and Magnetic Forces



Lab 1

Week 3: Magnetism and Electrodynamics

Ch.28: Sources of Magnetic Field; Biot-Savart and Ampere's Law

Ch.29: Electromagnetic Induction; Motors and Generators

Ch.30: Inductance; RL and RLC Circuits (time permitting)

Lab 2

Week 4: AC Circuits and Electromagnetic Waves

Ch.31: AC Circuits; Resonance (time permitting)

Ch.32: Maxwell's Equations, Plane e.m. Waves, Energy & Momentum in e.m. Waves