University of Pennsylvania

School of Arts and Sciences
Department of Physics and Astronomy

Physics 0151/0141 – Spring 2024

Course Overview
This course is an introduction to electricity and magnetism. The course begins with the subject of electrostatics (stationary charges), introducing the **electric force and the concept of electric field**. The principle of superposition and Gauss's Law are key techniques to calculate the electric field produced by many electric charges. We study electric potential energy and the concept of electric potential, including the storage of energy in capacitors and usefulness of dielectrics to increase storage capacity. Then the course moves on to currents (moving charges) and simple direct-current (DC) circuits with batteries, resistors, and capacitors.

The second half of the course continues with moving charges, introducing **the magnetic force and the concept of magnetic field**. The Biot-Savart Law and Ampere's Law are key techniques to calculate the magnetic field created by moving charges. Next, we study the important effect of electromagnetic induction with Faraday's Law, the basis for electric generators and motors. Here a time-varying magnetic flux induces an electric field. We extend circuit analysis to include inductors.

Electricity and Magnetism is described in four equations (Gauss's Laws, Ampere's Law, Faraday's Law) known as Maxwell's equations: arguably the most important intellectual achievement of humankind in the nineteenth century. **Light itself is an electromagnetic wave and a solution to Maxwell's equations**. The course will conclude by studying the properties of an electromagnetic wave and the superposition of waves giving interference and diffraction. The lab will also cover topics in geometric optics.

The mathematics used in this course is advanced. Math 1410 skills required for the first month of the class include integrations (eg calculation of electric field from a uniform distribution of charge along a line or arc) and vector calculus using Gauss's theorem to relate surface integral to a triple integral.

Textbook
The required textbook is Sears & Zemanksy's **"*University Physics*"** by Hugh D. Young and Roger A. Freedman, from the publisher Pearson. We will use Volume 2 of the 15th edition, but earlier versions are fine too. The textbook is available in the Penn Bookstore. You are not required to purchase additional materials such as Mastering Physics.

Canvas
Announcements, assignments, problem solutions, and grades will be available on Canvas. You should have access to two different "course sites", one for your "section" alone and one for all sections combined. All announcements of interest to all sections will be posted on the combined site.

Office hours
Office hours of all professors are open to all students and will be posted on the combined site.

Course Organization
Each individual section may organize its normal four hours of class differently: some sections will use some of the hours for active learning. The fifth hour, Thursdays at 5:15PM, will be used during the semester for the two

mid-term exams. The only dates when all students are required to be available for the Thursday hour are the dates for the two midterms. This time may also be used for review sessions, make-up lectures or additional problem-solving sessions, so you should keep it as "open" as possible. We understand that some students have classes that conflict with this time, and that these students have had to request special permission to enroll with this time conflict. These students should rest assured that attendance in any additional lectures is optional.

Class times
Classes will be held at the following times:

Section 401 **MW 8:30-10am, T 8:30-9:30am** Professor Martin Claassen
Section 402 **TR 12-1:30pm, W 1:45-2:45pm** Professor Josh KLEIN
Section 403 **MWF 10:15-11:15am, M 1:45-2:45** Professor Dylan Rankin
Section 404 **MF 1:45pm-3:15pm, W 12-1pm**, Professor Evelyn Thomson

The first day of classes is 18 January 2024 and the last day of classes is 1 May 2024. Drop period ends Feb 27, Spring break is March 2-10, withdraw period ends April 2, and final exam period is May 6-14.
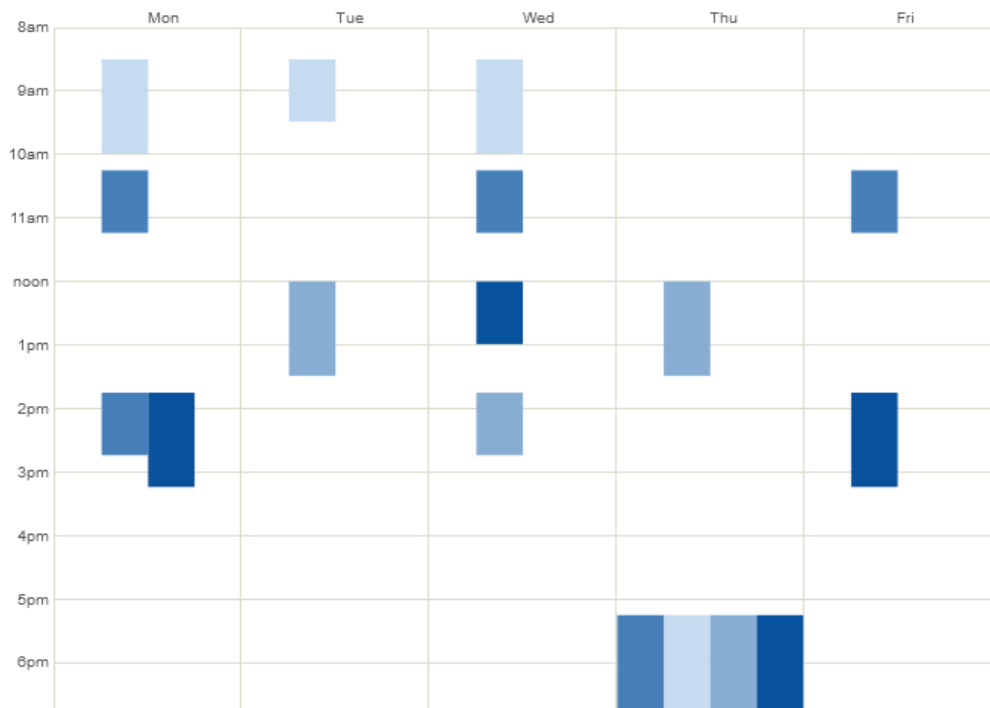
Exams, Quizzes, Homework

There are two required midterms and one required final exam:

      1st midterm **Thursday FEBRUARY 22 from 5:15-6:45 PM (on Ch. 21 – 23)**
      2nd midterm **Thursday MARCH 28 from 5:15–6:45 PM (on Ch. 24 – 28)**
      Final Exam **TBD during May 6-14 final exam period (cumulative, emphasis on 29, 30, 32, 35)**

Exams will take place simultaneously for all sections in separate lecture halls. You will be assigned to a lecture hall based on your section and/or last name. Your assigned exam room will be announced a few days prior to each exam. You must go to your assigned room. **During all exams and quizzes, the use of cell-phones – even just as calculators – is forbidden.** Bring an actual calculator with no communication or note storage capability! A formula sheet will be provided with the exam and will be posted in advance on Canvas.

Although exams may emphasize more recent material, all exams are cumulative – they may have problems that require knowledge of all of the course material covered up to that point in the exam.

Regrade requests must be submitted on separate sheet of paper. Do not write on the exam. You must include a worked solution of the problem and a brief explanation of your regrade request. Requests must be made within a week of the exams having been returned.

There will be no make-up exams for the midterms for any reason. Please inform your professor during the first week of the semester if you have a conflict with the midterm dates. *If you are ill or have a serious family emergency before the midterm, then please inform your professor* **before** *the midterm exam and see the instructions below on registration of absences.* In the event of an excused absence, the course grade will be based on the remaining exams and quizzes. If you fail to take a mid-term exam and the absence is not excused, you will receive a score of zero for that exam.

There is a make-up in September 2024 for the final exam. You may choose to take this make-up exam only if you have three final exams on the same calendar day as the Physics 141/151 final exam *and* the Physics exam is the middle exam. You must inform your instructor one month *in advance* of the final exam if you wish to exercise this option. If you are ill or have a serious family emergency that prevents you from taking the final exam, again you must inform your instructor **before** the final exam, and if your absence is excused, you must make up the final exam in September 2024.

Homework will be assigned each week with a due date. Some sections will have graded problems, all sections will check that homework has been completed. Please see your individual instructor's syllabus information to know what the policy is in your section. After the due date, worked solutions will be posted and any material that has been covered in the homework may be covered on an exam. Students will find it necessary **to complete all of the homework** in order to do well on the exams. *If you are ill or have a serious family emergency before an assignment is due, then please inform your professor* **before** *the deadline and see the instructions below on registration of absences.*

Quizzes: Depending on which section you are in, there will be about 10 quizzes during the semester. For sections taking quizzes, a calculator may be required and you are expected to bring a calculator for every quiz. No cell phones may be used during quizzes even as a calculator. The quizzes will be held each week during class at a time announced by your instructor. **The lowest quiz score will be dropped in determining the final quiz average;** you cannot be excused from additional quizzes due to illness, athletic events etc. If you miss a quiz, you will receive a score of zero for that quiz. **There are no make-ups.** Each section will have different quizzes, and the quiz scores of each section will be adjusted so that the average quiz score of all of the sections are identical. Each section may also have other components that enter the "in-class" grade, such as active learning scores, etc., and these will be treated in the same way.

Absences: Students may send absence notices notifying their instructors when they need to miss class due to extenuating circumstances. Submitting an absence notice does not excuse students from their course obligations. Students access Course Action Notices through a link on Path@Penn.

Physics 151 Labs

Labs begin the week of XXX in 2024. The rooms in which the experiments will be performed change from week to week, check the bulletin boards in the corridor on the third floor North and West corridors, these are located outside DRLB 3W5 and 3N18. The laboratory experiments are intended to supplement the lectures in the course by providing concrete demonstrations of the specific physical principals and by giving some insight into how those principles operate in practice.

Grading Rubric

To pass Physics 151, you must complete all the labs and obtain a passing grade in the labs.

Final Examination	40%
Midterm Exam 1	20%
Midterm Exam 2	20%
In-class work (quizzes, HW, active learning, etc.)	20%

Each section may break up the in-class grading fraction differently, please see your instructor's section site for details.

Academic Integrity

All students in Physics 0141 and 0151 are expected to adhere to the University of Pennsylvania's Code of Academic Integrity.

Study Advice

The lectures will cover the important points of the material and will work through detailed examples. The textbook provides additional worked examples and more information on each topic. One approach to getting the most out of both lectures and textbook is to take 15 minutes at the start of each week to skim through the assigned textbook chapter so you can see what to expect in class. After each class, review your lecture notes and the relevant sections of the textbook, and resolve the examples yourself.

Physics is best learned by working out problems. **Study steadily throughout each week, trying 4 or 5 problems every other day.** Just like learning to play a musical instrument or a sport, repeated practice is essential to build skills and to improve the long-term retention of those skills. Repeated practice will develop the critical thinking skills that you need to understand and solve problems on electricity & magnetism. During active learning sessions you will solve problems with your peers in a small group, and you are encouraged to study outside of class with a small group of your peers on the homework. You are welcome to attend the office hours of any professor teaching the class to find answers to your questions.

Warnings: Don't cram the night before a quiz as then you're doubly missing out on both the gain from repeated practice and the opportunity to find answers to your questions at office hours. Don't try to learn physics by only reading the worked-out homework solutions as that is like trying to learn to play the violin by only reading about it! It won't lead to good grades when confronted with a blank sheet of paper for a quiz or an exam! Consult worked solutions for the homework only after you have tried the problems.

Syllabus -2024

We will cover approximately one chapter per week. The course is fast moving so be careful not to fall behind! Sections that are "omitted" may be discussed in class but will not show up directly on exams. Not examinable on quizzes, midterms, and final exams are the following: Ch.31: Alternating Current, Ch. 33: The Nature and Propagation of Light, and Ch. 34: Geometric Optics.

Week beginning:

Thurs Jan 18	Ch. 21: Electric Charges and Electric Force
Mon Jan 22	Ch. 21: Electric Field from points, lines, arcs, rings, disks
Mon Jan 29	Ch. 22: Gauss's Law for Electric Field from spheres, cylinders, planes of charge
Mon Feb 5	Ch. 22: Gauss's Law for Electric Field from spheres, cylinders, planes of charge
Mon Feb 12	Ch. 23: Electric Potential
Mon Feb 19	Ch. 24: Capacitance and Dielectrics

First midterm exam on Thursday February 22nd at 5:15pm on Ch. 21-23 inclusive.

Mon Feb 26	Ch. 25-26: Simple circuits and R-C circuits (omit 26.3, 26.5)
Mon Mar 11	Ch. 27: Magnetic Forces (omit 27.8, 27.9)
Mon Mar 18	Ch. 28: Magnetic Fields: Biot-Savart & Ampere's Law
Mon Mar 25	Ch. 28

Second midterm exam on Thursday March 28th at 5:15pm on Ch. 24-28 inclusive.

Mon Apr 1	Ch. 29: Electromagnetic Induction, Faraday's Law (omit 29.8)
Mon Apr 8	Ch. 29
Mon Apr 15	Ch. 30: Inductance: R-L circuits and L-C circuits (omit 30.6)
Mon Apr 22	Ch. 32: Electromagnetic Waves (omit 32.5)
Mon Apr 29	Ch. 35: Interference

Last day of classes is Wednesday May 1

Final exam during May 6-14 TBD. Cumulative with emphasis on Ch. 29, 30, 32, and 35.