Physics 2426 Principles of Physics II

Instructor

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Office Hours: MW 1:00 – 2:00 pm, TT 1:30 – 3:00 pm, F 8:30 – 11:30 am
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Course Description

Content

Fundamental principles of physics, using calculus, for science, computer science, and engineering majors; the principles and applications of electricity and magnetism, including circuits, electromagnetism, waves, sound, light, and optics; experimental design, data collection and analysis, and preparation of laboratory reports; with emphasis on problem solving.

Prerequisites

Completion of PHYS 2425 – Principles of Physics I and MATH 2414 – Calculus II is required before taking Physics 2426.

Textbook

The textbook is *Matter & Interactions, 4th edition* by R. Chabay and B. Sherwood (John Wiley & Sons, 2015). Textbook Errata are at http://matterandinteractions.org/errata/.

Course Overview

This course deals with electric and magnetic interactions, which are central to the structure of matter, to chemical and biological phenomena, and to the design and operation of most modern technology. The ***main goal*** of the course is to have you engage in a process central to science: ***modeling a broad range of physical phenomena using a small set of powerful fundamental principles.***

Approach

The course will emphasize rigorous problem-solving in physics using a student-centered active learning environment. Class sessions will require students to be responsive, to think, and to perform hands-on tasks. Key concepts of new material will be discussed in short lectures. Lab time will be interspersed with classroom discussion. If you devote a sufficient amount of time each day to studying physics, you will be in a position to attack physics problems efficiently, based on a clear understanding of the fundamental physical principles that underlie all successful analyses.

Collaborative Work

This course encourages collaborative teamwork, a skill that is valued by most employers. As you study together, help your partners to get over confusions, ask each other questions, and critique each other's homework write-ups. Teach each other! You can learn a great deal by teaching. But remember that you are responsible for understanding all details of a problem solution.

Study requirements

In addition to your time in class each week, you are expected to spend about 10 hours studying outside of class. If you typically spend less than 8 hours in outside study, you are unlikely to be able to learn the material. Less well prepared students may find they need to spend even more time than this. If you typically spend more than 12 hours in outside study, it is extremely important that you consult with me about ways to study more efficiently.

It is important to keep up with the class. New concepts introduced in this course build on earlier ones, so mastering key concepts is critical. If you get behind, seek help right away!

Attendance policy

Attendance and effort are vital to success in this course. Class attendance keeps you well connected to the course, so that you know at all times what's going on, what are the most important points, etc., and gives you opportunities to ask questions and clear up confusions. Therefore, students are expected to be in attendance for every class session. However, everybody gets sick, has some emergency, needs to care for a friend or family member or similar stuff now and then. Therefore, all students will be allowed two excused absences, no documentation required. The third and fourth absences will be unexcused and after a fifth absence you will be dropped from the class. If you stop attending class and wish to avoid an "F" you must obtain an official drop form, have it signed, and take the completed form to the registrar's office before your fifth absence. See the current class schedule for the last day you can drop a class.

Assignments

WebAssign

Homework and reading assignments will be delivered and graded on WebAssign, a web-based homework system. WebAssign provides immediate feedback on the correctness of your answers and allows you to make another attempt on problems you initially miss. WebAssign access codes come packaged with a new textbook if purchased from the SPC bookstore or can be purchased online.

Readings

A key component of the course is the textbook, in which you are asked to analyze phenomena, to work out small examples, to make some of the steps in derivations, etc. *Class discussion will not cover all of the assigned material; it is essential that you study the textbook carefully.* You should work all the checkpoint questions in each reading assignment and seek help on any that give you difficulty.

Class sessions will be devoted to *discussion* of ideas, clarifying points of confusion, and activities of various kinds that allow you to practice using the concepts you have read about in the text. The text thus provides the *background* for these activities. *Therefore, it is essential to read the appropriate sections in the textbook BEFORE coming to class.* Your time in class will be largely ineffective if you have not studied the appropriate text sections prior to coming to class.

A reading assignment will be due in WebAssign before the start of each class session.

Homework

A WebAssign homework assignment will be due each week. For most problems in these assignments, you are allowed two free submissions per question part and a third submission that, if used, will incur a 25% penalty to your score on that part. It is therefore extremely important that you work each problem carefully on paper, in great detail, before submitting your answers. This practice is vital to learning the material and will also help you when reviewing the assignments before a test. Therefore, each student will maintain a portfolio of solved WebAssign problems. The portfolio should be maintained in a three ring binder and each problem should begin on a new sheet of loose leaf paper – no paper torn from a spiral notebook. After the assignment due date, some problems will be selected for detailed grading and the student will remove these selected problems from their portfolio and turn them in. Writing solutions provides practice in communicating your thinking process in a clear and precise way. Engineers (as well as professionals in other technical areas) actually spend a good amount of time working to communicate their ideas in a way that is comprehensible to others. Being able to write clearly is an important skill for an engineer. You will also find that writing good explanations of your thinking process will improve your understanding of the physics concepts you are studying. Communicating your thinking process on paper will require writing sentences and paragraphs in addition to equations and formulas. A well written solution will include verbal explanation stating what physics principles are used, appropriate well-labeled diagrams, symbolic solution before numerical values are substituted, and correct numerical result with correct number of significant figures and correct units. Students whose work is excessively messy or difficult to read may be required to produce typed solutions using a good word-processing package such as Microsoft Word or LaTeX.

Getting help with assignments

You should ask lots of questions in class to clear up any initial confusion you might have about a topic. I also encourage you to avail yourself of my help during office hours. You do not have to wait for my official office hours to get help; anytime I am in my office you are always welcome to come get help. If you fall behind for any reason, please let me know as soon as possible. The sooner I know about these situations, the better I can help you make up work. I will do what I can to help you complete the course satisfactorily.

Laboratory

During lab you will typically work in groups of three students on the following three kinds of activities:

- Experiments, involving measurement and analysis of data according to fundamental principles.
- Computer modeling, involving constructing 3-D models of electric and magnetic fields and their effects on charged objects. This will involve the VPython programming language. No previous programming experience is needed – I will teach you the basic concepts needed. Some computer modeling activities may need to be finished outside of class.
- Group problem solving, involving work on large, complex problems. In lab you may begin work on a large problem to be completed outside class or the entire problem may be solved during class.

You must attend class during the day the lab is done in order to receive credit. If you have an excused absence, you will be excused from the lab you missed, and your lab average will be taken from your remaining labs. If you miss a lab, you should work with your classmates to be sure you understand the missed lab activities since these will be covered on tests.

Tests

Tests

Three tests will be given as shown on the course calendar. Each test (except test 1) will consist of two parts. The first part will cover the new material. The second part will be an optional chance to show improvement in your understanding of the material from the previous test. This optional part can be used to improve your previous test grade. These tests will be closed-book, but some relevant formulas and constants will be provided. If you have an excused absence, you will need to contact me to make up the missed test.

Final exam

A comprehensive final exam will cover all of the course material. The final exam will be closed-book, but some relevant formulas and constants will be provided. It will be given during the scheduled final exam time as shown in the schedule of classes and on the course calendar.

Grade calculation

Your final grade will be assigned based on your overall, weighted class average using the weighting scheme shown below:

Weighting Scheme		
Task	Code	Weight
Reading	R	10%
Homework	H	15%
Lab	L	15%
Tests	T	36%
Final	F	24%

The letter grades will be based on a fixed scale as follows:

A: 89.5 – 100 B: 79.5 – 89.5 C: 69.5 – 79.5 D: 59.5 – 69.5 F: below 59.5

If everyone in the class does well, grades are not curved downward. Everyone can get an A. There usually is a "gray area" between two letter grades for borderline cases (grades within 0.5 points of the break point). Earning the higher grade in these cases depends on your interactions in class and whether your test and homework performance shows improvement during the course of the semester.

Miscellaneous information

In this class, the teacher will establish and support an environment that values and nurtures individual and group differences and encourages engagement and interaction. Understanding and respecting multiple experiences and perspectives will serve to challenge and stimulate all of us to learn about others, about the larger world and about ourselves. By promoting diversity and intellectual exchange, we will not only mirror society as it is, but also model society as it should and can be.

Students with disabilities, including but not limited to physical, psychiatric, or learning disabilities, who wish to request accommodations in this class should notify the Disability Services Office early in the semester so that the appropriate arrangements may be made. In accordance with federal law, a student requesting accommodations must provide acceptable documentation of his/her disability to the Disability Services Office. For more information, call or visit the Disability Services Office at Levelland (Student Health & Wellness Office) 806-716-2577, Reese Center (Building 8) & Lubbock Center 806-716-4675, or Plainview Center (Main Office) 806-716-4302 or 806-296-9611.

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Note to students with disabilities: If you have a disability-related need for reasonable academic adjustments in this course, provide the instructor with a letter of accommodation from the Disability Services Office. If you need immediate accommodations or physical access, please arrange to meet with the Disability Services Office before the next class meeting.

Core Objectives Addressed in this course:

Communication skills - to include effective written, oral, and visual communication

Critical Thinking skills - to include creative thinking, innovation, inquiry and analysis, evaluation and synthesis of information

Empirical and Quantitative skills - to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions

Teamwork skills - to include the ability to consider different points of view and to work effectively with others to support a shared purpose or goal

Broad Course Objectives

Learning objectives students should achieve after one year of introductory physics are listed below.

1. Students should develop a good functional understanding of physics.
   They should be able to:
   a. describe and explain physics concepts including knowing where and when they apply.
   b. apply physics concepts when solving problems and examining physical phenomena.
   c. apply concepts in new contexts (transfer).
   d. translate between multiple-representations of the same concept (for example: between words, equations, graphs, and diagrams).
   e. combine concepts when analyzing a situation.
   f. evaluate explanations of physical phenomena.
2. Students should begin developing expert-like problem solving skills.
   They should be able to:
   a. apply a small set of fundamental physical principles to a wide variety of physical situations.
   b. use these principles to satisfactorily solve standard textbook problems.
   c. model complicated physical systems by making approximations and idealizations in order to be able to apply fundamental principles.
   d. solve more challenging problems, including: context-rich ("Real World") problems, estimation problems, multi-step problems, multi-concept problems, problems requiring qualitative reasoning.
   e. evaluate other people's written solutions and solution plans.
3. Students should develop laboratory skills.
   They should be able to:
   a. interact (set up, calibrate, set zero, determine uncertainty, etc.) with an apparatus and make measurements.
   b. explain the physical principles underlying the operation of the apparatus, measurements, physical situation being studied and analysis of data.
   c. design, execute, analyze, and explain a scientific experiment to test a hypothesis.
   d. evaluate someone else's experimental design.
4. Students should develop technology skills.
   They should be able to:
   a. create simple computer models of physical situations.
   b. utilize a spreadsheet to graph and do curve fitting.
   c. find information on the web.
   d. use microcomputer, video, and web-based software and hardware for data collection and analysis.
5. Students should improve their communication, interpersonal, and questioning skills.
   They should be able to:
   a. express understanding in written and oral forms by explaining their reasoning to peers.
   b. demonstrate their knowledge and understanding of physics in written assignments.
   c. discuss experimental observations and findings.
   d. present a well-reasoned argument supported by observations and physical evidence.
   e. evaluate oral arguments, both their own and those espoused by others.
   f. function well in a group.
   g. evaluate the functioning of their group.
6. Students should retain and/or develop student cognitive attitudes and beliefs (expectations) that are favorable for learning physics with deep understanding.
   They should:
   a. believe that understanding physics means understanding the underlying concepts and principles instead of focusing on knowing and using equations.
   b. see physics as a coherent framework of ideas that can be used to understand many different physical situations.
   c. see what they are learning in the classroom as useful and strongly connected to the real world.
   d. be cognizant of the scientific process/approach and how to apply it.
   e. indicate a willingness to continue learning about physics and its applications.
   f. see themselves as part of a classroom community of learners.

Calendar

Phys 2426.001 Spring 2018

Week	Monday		Wednesday	
	Readings	Topics	Readings	Topics
1	01/15	Martin Luther King Day – No Class	01/17	Course Introduction; Physics I Review Lab – WebAssign Registration
2	01/22 **13.1 – 13.5**	Electric Charge; Electric Force; Electric Field of a Point Charge; Superposition Lab – VPython Review/Intro	01/24 **13.6 – 13.9**	Electric Field of a Dipole; Retardation Lab – VPEM01: Electric Field of a Point Charge
3	01/29 **14.1 – 14.4**	Charged Particles in Matter; Conservation of Charge; Polarization Lab – VPEM02: Electric Field of a Dipole	01/31 **14.5 – 14.8**	Polarization of Conductors; Properties of Metals in Equilibrium; Charging and Discharging; Feedback Lab – VPEM03: Motion in a Dipole Field
4	02/05 **15.1 – 15.3**	Calculating Electric Field of a Distributed Charge: Thin Rod, Ring Lab – Problem Solving	02/07 **15.4 – 15.9**	Calculating Electric Field of a Distributed Charge: Disk, Capacitor, Spherical Shell, Solid Sphere Lab – VPEM04: E-Field of a Charged Rod
5	02/12	**Test 1**	02/14 **16.1 – 16.5**	Electric Potential Energy; Electric Potential; Relating Potential and Field Lab – VPEM05: E-Field of a Charged Ring
6	02/19 **16.6 – 16.11**	Calculating Potential using Superposition; Field and Potential in Insulators; Electric Field Energy Density Lab – Test 1 Results and Assessment	02/21 **17.1 – 17.6**	Magnetic Field; Biot-Savart Law; Electron Current and Conventional Current; Biot-Savart Law for Currents Lab – Experiment: Measuring Potential Differences
7	02/26 **17.7 – 17.10**	Magnetic Field of Current Distributions: Long Straight Wire, Loop; Magnetic Dipole Moment Lab – VPEM06: B-Field of a Moving Charge	02/28 **17.11 – 17.14**	Bar Magnets; Atomic Structure of Magnets; Solenoid Lab – Experiment: Measuring B-Field of a Wire
8	03/05 **18.1 – 18.8**	Current in Different Parts of a Circuit; Electric Field and Current; Surface Charge Model of Electric Circuits Lab – Experiment: Magnetic Dipoles	03/07 **18.9 – 18.11**	Energy in Circuits; Using Conservation of Charge and Energy to Analyze Circuits Lab – Experiment: Investigating Simple Circuits
9	03/12	Spring Break	03/14	Spring Break
10	03/19 **19.1 – 19.4**	Capacitors; Non-Steady State Conditions in a Circuit; Resistors; Power in Circuits Lab – Experiment: Capacitors	03/21 **19.5 – 19.8, 19.11**	Batteries; Meters; Quantitative Analysis of RC Circuits; More Complex DC Circuits Lab – Experiment: Real Batteries
11	03/26	**Test 2**	03/28 **20.1 – 20.4**	Forces Produced by Magnetic Fields; Hall Effect Lab – Experiment: DC and RC circuits
12	04/02	Easter Holiday – No Class	04/04 **20.5 – 20.9**	Motional emf; Magnetic Torque; Potential Energy of a Magnetic Dipole; Motors and Generators Lab – Test 2 Results and Assessment
13	04/09 **21.1 – 21.5**	Patterns of Electric Field: Gauss's Law; Gauss's Law for Magnetism Lab – VPEM07: Moving Charge in B-Field	04/11 **21.6 – 21.10**	Patterns of Magnetic Field: Ampere's Law; Maxwell's Equations; Differential Form of Gauss's and Ampere's Laws Lab – Problem Solving
14	04/16 **22.1 – 22.4**	Changing Magnetic Fields and Curly Electric Fields: Faraday's Law; Maxwell's Equations Updated Lab – Experiment: Faraday's Law	04/18 **22.5 – 22.10**	Superconductors; Inductance; RL and LC circuits; Peculiar Circuit Examples; Differential Form of Faraday's Law Lab – Problem Solving
15	04/23	**Test 3**	04/25 **23.1 – 23.4**	Maxwell's Equations in Final Form; Electromagnetic Waves; Accelerated Charges Produce Radiation Lab – Problem Solving
16	04/30 **23.5 – 23.7**	Energy and Momentum in Radiation; Effects of Radiation on Matter; Light Propagation through Matter Lab – Test 3 Results and Assessment	05/02 **23.8 – 23.10**	Refraction and Snell's Law; Thin Lenses; Image Formation Lab – Experiment: Thin Lenses
17	05/07	**Final Exam – 1:00 to 3:00 pm**	05/09	