South Plains College
Common Course Syllabus: PHYS 2426
Revised 01/07/2020

Department: Science

Discipline: Physics

Course Number: PHYS 2426

Course Title: Principles of Physics II

Available Formats: conventional

Campuses: Levelland

Instructor:
David Hobbs
Office: S117D
Office Hours: MW 9:00 – 10:30 am, TT 8:00 – 9:00 am, F 8:00 – 11:00 am
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Course Description: Principles of physics for science, computer science, and engineering majors, using calculus, involving the principles of electricity and magnetism, including circuits, electromagnetism, waves, sound, light, and optics. Laboratory experiments supporting theoretical principles of electricity and magnetism, including circuits, electromagnetism, waves, sound, light, and optics; experimental design, data collection and analysis, and preparation of laboratory reports.

Prerequisite: PHYS 2425 Principles of Physics I and MATH 2414 Calculus II

Credit: 4 **Lecture:** 3 **Lab:** 3

Textbook: Matter & Interactions, 4th Edition (e-text through *Perusall.com* required, paper copy is optional)

Supplies: Scientific Calculator

This course partially satisfies a Core Curriculum Requirement:
Life and Physical Sciences Foundational Component Area (030)

Core Curriculum Objectives addressed:
- **Communications 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 competency skills**—to manipulate and analyze numerical data or observable facts resulting in informed conclusions
- **Teamwork**—to include the ability to consider different points of view and to work effectively with others to support a shared purpose or goal

Student Learning Outcomes:
Lecture Learning Outcomes - Upon successful completion of this course, students will:
1. Articulate the fundamental concepts of electricity and electromagnetism, including electrostatic potential energy, electrostatic potential, potential difference, magnetic field, induction, and Maxwell's Laws.

2. State the general nature of electrical forces and electrical charges, and their relationship to electrical current.
3. Solve problems involving the inter-relationship of electrical charges, electrical forces, and electrical fields.
4. Apply Kirchhoff's Laws to analysis of circuits with potential sources, capacitance, and resistance, including parallel and series capacitance and resistance.
5. Calculate the force on a charged particle between the plates of a parallel-plate capacitor.
6. Apply Ohm's law to the solution of problems.
7. Describe the effects of static charge on nearby materials in terms of Coulomb's Law.
8. Use Faraday's and Lenz's laws to find the electromotive forces.
9. Describe the components of a wave and relate those components to mechanical vibrations, sound, and decibel level.
10. Articulate the principles of reflection, refraction, diffraction, interference and superposition of waves.
11. Solve real-world problems involving optics, lenses, and mirrors.

Lab Learning Outcomes - Upon successful completion of this course, students will:

1. Prepare laboratory reports that clearly communicate experimental information in a logical and scientific manner.
2. Conduct basic laboratory experiments involving electricity and magnetism.
3. Relate physical observations and measurements involving electricity and magnetism to theoretical principles.
4. Evaluate the accuracy of physical measurements and the potential sources of error in the measurements.
5. Design fundamental experiments involving principles of electricity and magnetism.
6. Identify appropriate sources of information for conducting laboratory experiments involving electricity and magnetism.

Student Learning Outcomes Assessment: A midterm exam and a final exam will be administered to assess how well students have grasped the fundamental principles studied and their ability to apply those principles in new contexts.

Course Evaluation: Student grades will be based on reading assignments, weekly homework assignments, lab work, a semester project, a midterm exam, and a final exam. Final grades will be assigned based on overall, weighted average using the weighting scheme shown below:

Weighting Scheme		
Task	Code	Weight
Reading	R	10%
Homework	H	20%
Lab	L	20%
Semester Project	P	10%
Midterm	M	20%
Final	F	20%

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

Borderline cases (grades within 0.5 points of the break point) will be decided based on class attendance and participation.

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. A student missing any part of the lecture or lab (including arriving late or leaving early) for a given class session may be considered absent. Students absent five times during the semester will be dropped from the class with an X (if passing at the time of the fifth absence) or F (if failing at the time of the fifth absence). It is the student's responsibility to keep track of how many absences they have. In-class work missed can be made up for the student's first two absences if the student can supply documentation showing the absence is excusable. Make-up work must be completed by the end of the week following the week in which the absence occurred. Any make-up work requiring use of the lab must be done on Friday mornings before 11:30 am.

Plagiarism and Cheating: Students are expected to do their own work on all projects, quizzes, assignments, examinations, and papers. Failure to comply with this policy will result in an F (grade of zero) for the assignment and can result in an F for the course if circumstances warrant.

Plagiarism violations include, but are not limited to, the following:

1. Turning in a paper that has been purchased, borrowed, or downloaded from another student, an online term paper site, or a mail order term paper mill;
2. Cutting and pasting together information from books, articles, other papers, or online sites without providing proper documentation;
3. Using direct quotations (three or more words) from a source without showing them to be direct quotations and citing them; or
4. Missing in-text citations.

Cheating violations include, but are not limited to, the following:

1. Obtaining an examination by stealing or collusion;
2. Discovering the content of an examination before it is given;
3. Using an unauthorized source of information (notes, textbook, text messaging, internet, apps) during an examination, quiz, or homework assignment;
4. Entering an office or building to obtain unfair advantage;
5. Taking an examination for another;
6. Altering grade records;
7. Copying another's work during an examination or on a homework assignment;
8. Rewriting another student's work in Peer Editing so that the writing is no longer the original student's;
9. Taking pictures of a test, test answers, or someone else's paper.

Student Code of Conduct Policy: Any successful learning experience requires mutual respect on the part of the student and the instructor. Neither instructor nor student should be subject to others' behavior that is rude, disruptive, intimidating, aggressive, or demeaning**.** Student conduct that disrupts the learning process or is deemed disrespectful or threatening shall not be tolerated and may lead to disciplinary action and/or removal from class.

Diversity Statement: 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.

Disability Statement: 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) 806-716-4675, or Plainview Center (Main Office) 806-716-4302 or 806-296-9611.

Nondiscrimination Policy: South Plains College does not discriminate on the basis of race, color, national origin, sex, disability or age in its programs and activities. The following person has been designated to handle inquiries regarding the non-discrimination policies: Vice President for Student Affairs, South Plains College, 1401 College Avenue, Box 5, Levelland, TX 79336. Phone number 806-716-2360.

Title IX Pregnancy Accommodations Statement: If you are pregnant, or have given birth within six months, Under Title IX you have a right to reasonable accommodations to help continue your education. To activate accommodations you must submit a Title IX pregnancy accommodations request, along with specific medical documentation, to the Director of Health and Wellness. Once approved, notification will be sent to the student and instructors. It is the student's responsibility to work with the instructor to arrange accommodations. Contact the Director of Health and Wellness at 806-716-2362 or email cgilster@southplainscollege.edu for assistance.

Note: The instructor reserves the right to modify the course syllabus and policies, as well as notify students of any changes, at any point during the semester.

Physics 2426 Principles of Physics II

Instructor

David Hobbs
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Course Description

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!

Assignments

Readings in Perusall

Perusall is a collaborative reading and annotation tool which turns reading assignments from an isolated solitary activity into an engaging collective social interaction. While reading your text in Perusall you can highlight a selection and ask a question or post a comment which will start a new discussion thread; you can also add a reply or comment to an existing thread. Each thread is like a chat with one or more of your classmates. This collaborative questioning and answering helps you master readings faster, understand the material better, and get more out of your physics class. For more information see the handout "How Perusall Works". As you read the text, you should work each checkpoint question and keep these in your course portfolio – see below.

Homework

Homework will consist of five or six problems each week requiring detailed written solutions. Writing good 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 significant amount of time communicating 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 poorly explained will be asked to rewrite the assignment.

Course Portfolio

You will maintain all your course work in a three-ring binder. The binder must have separate sections for your checkpoint solutions, in-class problem solutions, written homework solutions, and lab work. You may also include sections for your reading notes and class notes if you want. These materials may be collected for inspection at any time. Please make certain that you keep your portfolio up-to-date and bring it with you to every class meeting and when seeking help during office hours. Maintaining a well-organized, up-to-date portfolio will provide you an extremely useful tool for reviewing before exams.

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.

Semester Project

Semester projects will be chosen in consultation with the instructor. Possibilities include numerical simulations that expand beyond what we do in lab, an experimental project carried out and reported by the student, extended analysis of a challenging, more realistic problem to demonstrate application of fundamental physics principles, or some other creative project you get approved as long as it demonstrates mastery of the basic physics principles studied. You must decide on your project and have it approved by the instructor before the midterm exam. A first draft of your project report will be due four weeks after the midterm exam. Final project reports will be due the week before the final exam.

Exams

Midterm exam

A single midterm exam will be given approximately half way through the semester. The date of the exam is shown on the course calendar. The exam 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 exam.

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.

Specific Course Objectives

Learning objectives students should achieve to successfully complete this course:

1. Describe how the field concept is employed to explain the interaction between charged objects.
2. Calculate electric and magnetic fields due to collections of individual source charges and/or continuous distributions of source charges. Sketch a diagram using arrows to show the electric or magnetic field.
3. Calculate forces exerted by electric and magnetic fields on charges. Use these forces in analyzing the motion of charges in the fields.
4. Produce computational models displaying the electric or magnetic field of various charge arrangements and predicting the motion of a charged particle in the field.
5. Describe the effects of electric and magnetic fields on matter, using appropriate sketches of charge arrangements in and on the material and mathematically relating polarization, drift speed, current density, and Hall voltage to the fields.
6. Use conservation of charge to reason both qualitatively and quantitatively about processes involving the rearrangement of charge in and/or on both insulators and conductors and about the steady state current in a circuit.
7. Mathematically relate electric field, electric potential, and electric potential energy and apply conservation of energy to the motion of charged particles in electric fields.

8. Use superposition to find the electric potential of a collection of point charges or a continuous charge distribution and calculate differences in electric potential in and around conductors and insulators.
9. Describe current flows in terms of surface charge distributions, discussing both steady state and transient behavior. Apply conservation of energy to circuits with steady state current flows.
10. Relate the macroscopic and microscopic descriptions of circuits and analyze simple circuits in terms of the macroscopic properties of resistance, capacitance, current, and potential difference.
11. Use Gauss's law and Ampere's law to relate charge and current to the patterns of electric and magnetic fields in space and use this to calculate electric and magnetic fields from sufficiently symmetric charge and current arrangements.
12. Use Faraday's law to relate time-varying magnetic fields to electric fields, calculating the emf and induced current produced around closed circuits.
13. Use inductance to relate the changing magnetic field flux in a coil to the induced emf along the coil. Analyze simple circuits including inductors.
14. Explain the necessity of the term Maxwell added to Ampere's law. Demonstrate the consistency of a simple traveling pulse of electromagnetic field with Maxwell's equations and enumerate the conditions needed for this consistency.
15. Calculate the radiative electric and magnetic fields produced by an accelerating source charge.
16. Calculate the energy density in electric and magnetic fields and use the Poynting vector to relate the energy flux and momentum flux to the electromagnetic field.
17. Use re-radiation to explain various effects of radiation on matter such as scattering, why some materials are opaque, polarization, resonance, absorption, reflection, and refraction.

Calendar

Phys 2426.001 Spring 2020

Week	Monday		Wednesday	
	Readings	Topics	Readings	Topics
1	01/13	Course Introduction; *Perusall* Registration	01/15 **13.1 – 13.5**	Electric Charge; Electric Force; Electric Field of a Point Charge; Superposition Lab – Glowscript/VPython Review/Intro
2	01/20	Martin Luther King Day – No Class	01/22 **13.6 – 13.9**	Electric Field of a Dipole; Retardation Lab – VPEM01: Electric Field of a Point Charge
3	01/27 **14.1 – 14.4**	Charged Particles in Matter; Conservation of Charge; Polarization Lab – VPEM02: Electric Field of a Dipole	01/29 **14.5 – 14.8**	Polarization of Conductors; Properties of Metals in Equilibrium; Charging and Discharging; Feedback Lab – VPEM03: Motion in a Dipole Field
4	02/03 **15.1 – 15.3**	Calculating Electric Field of a Distributed Charge: Thin Rod, Ring Lab – Problem Solving	02/05 **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	02/10 **16.1 – 16.5**	Electric Potential Energy; Electric Potential; Relating Potential and Field Lab – VPEM05: E-Field of a Charged Ring	02/12 **16.6 – 16.11**	Calculating Potential using Superposition; Field and Potential in Insulators; Electric Field Energy Density Lab – Problem Solving
6	02/17 **17.1 – 17.6**	Magnetic Field; Biot-Savart Law; Electron Current and Conventional Current; Biot-Savart Law for Currents Lab – Experiment: Measuring Potential Differences	02/19 **17.7 – 17.10**	Magnetic Field of Current Distributions: Long Straight Wire, Loop; Magnetic Dipole Moment Lab – VPEM06: B-Field of a Moving Charge
7	02/24 **17.11 – 17.14**	Bar Magnets; Atomic Structure of Magnets; Solenoid Lab – Experiment: Measuring B-Field of a Wire	02/26 **18.1 – 18.3**	Current in Different Parts of a Circuit; Electric Field and Current Lab – Experiment: Magnetic Dipoles
8	03/02 **18.4 – 18.8**	Surface Charge Model of Electric Circuits Lab – Experiment: Measuring Current	03/04	**Midterm Exam**
9	03/09 **18.9 – 18.11**	Energy in Circuits; Using Conservation of Charge and Energy to Analyze Circuits Lab – Experiment: Investigating Simple Circuits	03/11 **19.1 – 19.4**	Capacitors; Non-Steady State Conditions in a Circuit; Resistors; Power in Circuits Lab – Experiment: Capacitors
10	03/16	Spring Break	03/18	Spring Break
11	03/23 **19.5 – 19.11**	Batteries; Meters; Quantitative Analysis of RC Circuits; More Complex DC Circuits Lab – Experiment: Real Batteries	03/25 **20.1 – 20.4**	Forces Produced by Magnetic Fields; Hall Effect Lab – Experiment: DC and RC circuits
12	03/30 **20.5 – 20.7**	Motional emf; Magnetic Torque Lab – Problem Solving	04/01 **20.8 – 20.9**	Potential Energy of a Magnetic Dipole; Motors and Generators Lab – Constructing a Simple Motor
13	04/06 **21.1 – 21.5**	Patterns of Electric Field: Gauss's Law; Gauss's Law for Magnetism Lab – VPEM07: Moving Charge in B-Field	04/08 **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	04/13	Easter Holiday – No Class	04/15 **22.1 – 22.4**	Changing Magnetic Fields and Curly Electric Fields: Faraday's Law; Maxwell's Equations Updated Lab – Experiment: Faraday's Law
15	04/20 **22.5 – 22.10**	Superconductors; Inductance; RL and LC circuits; Peculiar Circuit Examples; Differential Form of Faraday's Law Lab – Problem Solving	04/22 **23.1 – 23.4**	Maxwell's Equations in Final Form; Electromagnetic Waves; Accelerated Charges Produce Radiation Lab – Problem Solving
16	04/27 **23.5 – 23.7**	Energy and Momentum in Radiation; Effects of Radiation on Matter; Light Propagation through Matter Lab – Problem Solving	04/29 **23.8 – 23.10**	Refraction and Snell's Law; Thin Lenses; Image Formation Lab – Experiment: Thin Lenses
17	05/04	**Final Exam – 1:00 to 3:00 pm**	05/06	