Physics 2425 Principles of Physics I

Instructor

David Hobbs
Office: S117D
Office Hours: MW 1:00 – 2:00 pm, TT 9:00 – 10:30 am, F 9:00 am – 12:00 pm
Phone: 806-716-2639
email: dhobbs@southplainscollege.edu

Course Description

Content

Fundamental principles of physics, using calculus, for science, computer science, and engineering majors; the principles and applications of classical mechanics, including harmonic motion, physical systems and thermodynamics; experimental design, data collection and analysis, and preparation of laboratory reports; with emphasis on problem solving.

Prerequisites

Completion of MATH 2413 - Calculus I is required before taking Physics 2425.

Textbook

The textbook is *Matter & Interactions, 4th edition* by R. Chabay and B. Sherwood (John Wiley & Sons, 2015). There is no lab manual for this course. Textbook Errata are at http://matterandinteractions.org/errata/.

Course Overview

In this course we will be examining the nature of matter and its interactions. The variety of phenomena that we will be able to explain and understand is very wide, ranging from the orbit of a planet to the speed of sound in a solid. 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. 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

Practice problems will be administered using WebAssign, a web-based homework system. WebAssign provides immediate feedback on the correctness of your answers and allows you to make additional attempts 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.*

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.

Getting help

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. 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 physical systems and their motion. 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.

Grades

Your final grade will be assigned based on how well you demonstrate proficiency on the learning objectives. See the grading handout for the details.

A	I am Advanced on six of the learning objectives and Proficient on the remaining learning objectives.
B	I am Advanced on at least one objective and Proficient on the remaining learning objectives.

C	I am Proficient on at least seven of the learning objectives.
D	I am Proficient on at least three of the learning objectives.
F	I am Proficient on less than three of the learning objectives.

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.

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, 806-894-9611

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

Course Learning Objectives:

Primary Course Objective

After completing this course, I will be able to construct appropriate models to explain or predict a broad range of real physical phenomena, based on the fundamental momentum, energy, and angular momentum principles. I will simplify and idealize messy, complex, real-world systems using approximations and simplifying assumptions, explicitly stating those approximations and assumptions. I will work from the fundamental principles, starting with general statements of those principles and working to particular solutions for the specific system at hand.

You will be assessed on ten specific learning objectives:

PS – General Problem Solving Skills
K – Kinematics: Describing Motion
MP – Momentum Principle
F – Forces
EP – Energy Principle
AMP – Angular Momentum Principle
SM – Statistical Mechanics
L – Lab Report Writing
CM – Computational Modeling
P – Class Participation

See the grading handout for detailed descriptions of each objective.

Calendar

Phys 2425.001 Fall 2017

Week	Monday		Wednesday	
	Readings	Topics	Readings	Topics
1	08/28	Course Introduction, WebAssign Registration, Vectors	08/30 **1.1 – 1.7**	Detecting Interactions: Newton's 1st Law; Position Update Equation
2	09/04	Labor Day – No Class	09/06 **1.8 – 1.11**	Momentum; Change in Momentum; Using Momentum to Update Position
3	09/11 **2.1 – 2.5**	The Momentum Principle (Newton's 2nd Law); Iterative Prediction of Motion – Constant Net Force; Analytical Prediction of Motion – Constant Net Force	09/13 **2.6 – 2.7**	Iterative Prediction of Motion – Varying Net Force
4	09/18 **3.1 – 3.6**	Fundamental Interactions; Gravitational Force; Reciprocity (Newton's 3rd Law); Predicting the Motion of Gravitationally Interacting Objects	09/20 **3.7 – 3.15**	Electric Force; Strong and Weak Interactions; Momentum Conservation; Momentum Principle for Multiparticle Systems; Collisions
5	09/25 **4.1 – 4.8**	Atomic Model of Contact Interactions: Tension Forces, Normal Forces, Frictional Forces	09/27 **4.9 – 4.14**	Speed of Sound in a Solid; Derivative Form of the Momentum Principle; Analytical Solution for a Spring-Mass System
6	10/02 **5.1 – 5.5**	Determining Unknown Forces Using the Derivative Form of the Momentum Principle	10/04 **5.6 – 5.10**	Applying the Derivative Form of the Momentum Principle to Curving Motion
7	10/09	**In-Class Assessment 1**	10/11 **6.1 – 6.6**	The Energy Principle applied to a Single Particle System
8	10/16 **6.7 – 6.11**	The Energy Principle applied to Multiparticle Systems; Gravitational Potential Energy; Electric Potential Energy	10/18 **6.12 – 6.15** **7.1 – 7.3**	Nuclear Energy; Elastic Potential Energy of a Spring-Mass System; Potential Energy of Interacting Neutral Atoms
9	10/23 **7.4 – 7.11**	Energy Principle applied to Large Multiparticle Systems: Internal Energy, Microscopic Work (Heat Transfer); Energy Dissipation	10/25 **8.1 – 8.7**	Energy Quantization
10	10/30 **9.1 – 9.2**	Separation of Kinetic Energy in Multiparticle Systems into Translational, Rotational, and Vibrational Kinetic Energy; Moment of Inertia	11/01 **9.3 – 9.4**	Modeling a System as a Point Particle and Modeling a System as an Extended Object; Detailed Model of Friction
11	11/06 **10.1 – 10.6**	Collisions – Applying both Momentum and Energy Principles Together	11/08 **10.7 – 10.12**	Rutherford's Discovery of the Nucleus; Relativistic Particle Collisions
12	11/13	**In-Class Assessment 2**	11/15 **11.1 – 11.6**	Angular Momentum and the Angular Momentum Principle
13	11/20 **11.7 – 11.11**	Combining All Three Fundamental Principles in Problem Solving; Angular Momentum Quantization	11/22	Thanksgiving – No Class
14	11/27 **12.1 – 12.4, 12.7**	Fundamental Assumption of Statistical Mechanics; Entropy and the Second Law of Thermodynamics	11/29 **12.5 – 12.8**	Definition of Temperature ; Predicting the Specific Heat Capacity of Solids; The Boltzmann Distribution
15	12/04	**In-Class Assessment 3 – Part 1**	12/06	**In-Class Assessment 3 – Part 2**
16	12/11	**In-Class Assessment 4 – Part 1** **1:00 – 3:00 pm**	12/13	**In-Class Assessment 4 – Part 2** **3:15 to 5:15 pm**