SYLLABUS

Meeting Times

Lectures:	MWF, 8:00 - 8:50 am
Room:	Hugel 100
Office Hours:	M 1:30 pm - 3 pm
	T 10:30 am - 12 pm
	F 2:30 pm - 4 pm

Contact Info:
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Course Overview - This course is a calculus-based introduction to the foundations of mechanics, intended for students majoring in science or engineering. Our emphasis will be on identifying, understanding, and applying the fundamental principles of classical mechanics based on Newton's laws of motion and how they can be applied to describe and predict how objects move and interact with each other in the world around us. The course will cover fundamental concepts such as energy, momentum, force, and power and the relationships between them, concepts which underlie all fields of science and engineering.

Learning Outcomes - By the end of this course, you will be able to

- describe phenomena in the physical world using the language of mathematics including calculus concepts and vector quantities
- understand and apply the fundamental principles of mechanics, in particular Newton's laws of motion, to a variety of physical situations
- demonstrate the ability to formulate a testable hypothesis based upon acquired physical data
- identify conserved quantities in a physical system and apply the corresponding conservation laws to extract information about that system
- apply qualitative and quantitative problem-solving skills to answer concrete questions and communicate your reasoning to others
- collect and analyze experimental data relevant to testing a hypothesis and evaluate whether the evidence supports, refutes, or leads to the revision of the hypothesis
- create, interpret, and critically evaluate graphs, tables, and models of physical data
- understand scientific uncertainty and how it is reduced with additional data acquisition and hypothesis testing
- engage in the process of doing physics, including such tasks as developing and testing models, interpreting experimental data, solving problems, and communicating results

Prerequisites MATH 161 or permission of instructor

Course Texts

- University Physics with Modern Physics, 14nd ed. by Young and Freedman with Mastering Physics
  **If you did not purchase Mastering Physics with the text, you can buy it online at http://www.MasteringPhysics.com/*
- Physics 131 Laboratory Manual

Course Policies - Attendance is mandatory and I encourage you to read the relevant sections of the text before class so that the material is not completely unfamiliar to you when we start discussing it together.

Grading Grades are determined on the following basis:

Problem Sets:	20%
Weekly Quizzes:	10%
Labs:	20%
Mid-term Exam I:	15%
Mid-term Exam II:	15%
Final Exam:	20%

Laboratory - The laboratory is an essential part of this course. There you will see and experiment with many of the concepts we cover in class and learn how to approach, analyze, and communicate details of an experiment. You must complete all of the assigned experiments; you will be unable to pass this course unless you both attend all laboratory meetings **and** receive a passing grade for the laboratory part of the course. Further details will be provided by your laboratory instructor.

Assignments:

Problem Sets - Homework will be assigned on a weekly basis and will generally be due on Wednesdays, turned in to me at the start of class. Late assignments are generally not accepted, unless you have received an exemption from me ahead of time. Please plan to manage your time accordingly.

Weekly problem sets will generally consist of a combination of online and written problems. Online problems will be through Mastering Physics. For at least one of the written problems each week, you will be required to work as a group. I will assign groups of ~4 students and the groups will rotate every 3 weeks or so. **For your group problem, each member must write up the solution *individually* and must include the names of the other group members on the write up.** I encourage you to work with your group on the rest of the problems in the assignment as well! The purpose of these group problems are to introduce you to more challenging and interesting concepts and to give you additional practice developing problem-solving skills and insight into the physics we are studying. Working with a variety of others will help inform your problem-solving by bringing potentially disparate approaches/opinions to the table, forcing you to discuss and debate with one another as you work towards a common solution.

Collaboration – Collaboration among students on homework is not only allowed, it is very much encouraged! However, any work you turn in must be written by you, in your own words, and faithfully represent your understanding of the course material. Collaboration on exam questions is never permitted. Directly copying homework solutions or exam answers will result in a zero for the assignment or exam and possible failure for the course, depending on the severity and subject of the academic violation.

A few notes about assigned problem sets:

- It is to your advantage to do the assigned homework. I have chosen the problems to help you learn the material. Physics can be a complicated thing, but repeatedly working with it (and at it) is essential in order to gain physical intuition and get comfortable with the mathematical theory.
- Feel free to use computational aids for some of the mathematics if you prefer, but note that there is some advantage to working things out by hand. Not being able to solve problems "by inspection" could end up hurting you on an exam where you may not be permitted to use computational tools and, frequently, there are mathematical tricks you can use to easily simplify a problem that you will not appreciate if you ask a program to do the work.
- I encourage you to work on these problem sets collaboratively, though I do expect you to take 10-15 minutes to give a problem "the old college try" on your own so you enter into discussion with others having some ideas to contribute. You will make your life easier as well as improve your understanding if you work with others (either by explaining it or having it explained to you). I expect solutions to be written up individually (or, if your handwriting is illegible, typed), and all collaboration should be properly acknowledged.
- I expect your problem sets to be clearly and logically organized. This means that:
    - Each problem should start on a **new** page.
    - Write out the problem (or an abbreviated version containing all relevant information). Draw a picture/diagram if useful.
    - Clearly work out the problem, commenting your work as you go. Problem sets should never contain just the math; use words to describe what you are doing and to reference where in the text an equation came from and why it is relevant.
    - Remember to keep track of units (by writing them out with all your calculations)! Do the units work out as you expect they ought to at the end of a problem? Dimensional analysis is the easiest check to ensure you have tackled the problem correctly.
    - Box your final solutions or major milestones as you do the problem. This makes it easier to grade and also for you to follow your own work when you look it over.
    - Comment on the significance of your answer. (Does it make sense? Is it what you expected? Why or why not?)
    - Attach a cover page to your problem set. This can be the problem sheet or something else, but it should have your name and a clear acknowledgement of all those you have collaborated with on the assignment. This includes fellow students, faculty, SIs, etc. (anyone who you consulted or worked with).
    - Please see me if you have any questions about this! I know it seems a bit ridiculous listed out like this, but I promise that it will serve you well in the long run. Writing in science is different from the traditional humanities paper, but the point is the same: to clearly and effectively communicate something. This will help you to accomplish that.

Weekly Quizzes - One day each week, I will give a brief quiz at the start of class where you will have 10 minutes to answer a few largely conceptual questions related to the new material we will be covering. The purpose of these quizzes are to ensure that you are reading over the material before class and arriving at class prepared and familiar with the terminology we will be using. They also serve as an attendance policy of sorts; if you do not attend class, you will not receive credit for that day's quiz. At the end of the semester, your lowest quiz score will be dropped.

Exams There will be two in-class exams and a comprehensive final for this class. For each exam, I will provide you with an equation sheet which will be made available ahead of time so you may familiarize yourself with it. On the exams, I want you to demonstrate that you know and understand how to apply the concepts/formulas from class; I want you to focus on the physics, not on memorizing a bunch of equations.

The point of this class is to understand and be able to use the basic principles of classical physics, not to memorize the solutions to specific types of problems. Accordingly, exam problems will not be identical to any particular homework problems, but they will be based on the same principles and can be solved using similar strategies. Practice (via SI session attendance and homework assignments) will be essential in developing the skills and intuition of the physics needed to do well on exams.

Supplemental Instruction - SIs will be holding problem help sessions multiple times during the week. These sessions are useful ways to practice applying the physics we discuss in class.

Accommodations - In accordance with Lafayette College policy, reasonable academic accommodation and support services are available to students who have a documented disability. It is your responsibility to provide me with the appropriate paperwork from the Accessibility Services Office. More information is available at https://hub.lafayette.edu/.

Gender Inclusion - This is a gender-inclusive classroom. I have been provided with a class roster and your legal names. I will gladly honor any requests to be addressed by a different name or pronoun than appears on the class. Please make me aware of any preferences.

Moodle Privacy Statement - Please note that Moodle contains student information that is protected by the Family Educational Right to Privacy Act (FERPA). Disclosure to unauthorized parties violates federal privacy laws. Courses using Moodle will make student information visible to other students in this class. Please remember that this information is protected by these federal privacy laws and must not be shared with anyone outside the class. Questions can be referred to the Registrar's Office.

Federal Credit Hour Compliance Statement - The student work in this course is in full compliance with the federal definition of a four credit hour course. Please see the Registrar's Office web site (https://registrar.lafayette.edu/wp-content/uploads/sites/193/2013/04/Federal-Credit-Hour-Policy-Web-Statement.doc) for the full policy and practice statement.

Common Course of Study Outcomes - Statement This course (and particularly the lab component) will promote the following outcomes for Natural Sciences (NS) within the Lafayette Common Course of Study:

- NS1: Employ the fundamental elements of the scientific method in the physical and natural world.
- Identify and/or formulate a testable scientific hypothesis.
- Generate and evaluate evidence necessary to test and/or revise a hypothesis.
- NS2: Create, interpret, and evaluate descriptions and representations of scientific data including graphs, tables, and/or models.
- NS3: Understand how scientific uncertainty informs the evaluation of hypotheses.

Tentative Lecture Schedule and Associated Readings:

Week 1	Jan. 28	Introduction	Ch. 1:1-2	
	Jan. 30	Units and Velocity	Ch. 1:3-6	
	Feb. 1	Working with Vectors	Ch. 1:7-10	PS 1 due (Fri.)
Week 2	Feb. 4	Position, Velocity, and Acceleration	Ch. 2:1-3	
	Feb. 6	Motion with Constant Acceleration	Ch. 2:4	PS 2 due
	Feb. 8	Falling Motion	Ch. 2:5-6	
Week 3	Feb. 11	Motion in Two and Three Dimensions	Ch. 3:1-2	
	Feb. 13	Projectile Motion	Ch. 3:3	PS 3 due
	Feb. 15	Force and Newton's First Law	Ch. 4:1-2	
Week 4	Feb. 18	Newton's Second Law	Ch. 4:3-4, 6	
	Feb. 20	Applying Newton's Second Law	Chs. 5:1-3, 6:3	PS 4 due
	Feb. 22	Newton's Third Law	Ch. 4:5	
Week 5	Feb. 25	Circular Motion	Chs. 3:4, 5:4	
	Feb. 27	Newton's Universal Law of Gravitation	Ch. 13:1-2	PS 5 due
	Mar. 1	Work and Kinetic Energy	Ch. 6:1-3	
Week 6	Mar. 4	**Exam I**		
	Mar. 6	Potential Energy: An Introduction	Ch. 7:1	
	Mar. 8	Potential Energy: Applications	Ch. 7:1	PS 6 due (Fri.)
Week 7	Mar. 11	Energy Problems	Ch. 7:2	
	Mar. 13	Conservative Forces and Potential Energy	Ch. 7:3-4	PS 7 due
	Mar. 15	Gravitational Potential Energy	Ch. 13:3-4	
Week 8	Mar. 18	No class (Spring Break)		
	Mar. 20	No class (Spring Break)		
	Mar. 22	No class (Spring Break)		
Week 9	Mar. 25	Power	Ch. 6:4	
	Mar. 27	Momentum	Ch. 8:1-2	PS 8 due
	Mar. 29	Momentum Conservation and Collisions	Ch. 8:3	
Week 10	Apr. 1	Elastic and Inelastic Collisions	Ch. 8:4	
	Apr. 3	Center of Mass	Ch. 8:5-6	PS 9 due
	Apr. 5	Introduction to Rotation	Ch. 9:1	
Week 11	Apr. 8	Rotational Kinematics	Ch. 9:2-3	
	Apr. 10	Energy of Rotation and Moments of Inertia	Ch. 9:4	PS 10 due
	Apr. 12	**Exam II**		
Week 12	Apr. 15	Evaluating Moments of Inertia	Ch. 9:5-6	
	Apr. 17	Torque	Ch. 10:1-2	PS 11 due
	Apr. 19	Angular Dynamics Problems	Ch. 10:3	
Week 13	Apr. 22	Angular Momentum	Ch. 10:4-5	
	Apr. 24	Vector Torque and Angular Momentum	Ch. 10:6-7	PS 12 due
	Apr. 26	Simple Harmonic Motion: Part I	Ch. 14:1-3	
Week 14	Apr. 29	Simple Harmonic Motion: Part II	Ch. 14:4-6	
	May 1	Wave Properties: Part I	Ch. 15:1-2	PS 13 due
	May 3	Wave Properties: Part II	Ch. 15:3-5	
Week 15	May 6	Superposition and Interference	Ch. 15:6-7	
	May 8	Standing Waves	Ch. 15:7-8	
	May 10	Catch-Up/Review		PS 14 due (Fri.)

FINAL EXAM (comprehensive): date and time TBD by the Registrar