SYLLABUS

Meeting Times

Lectures:	MWF 2:10-3:00 pm
Room:	Hugel Science Center 100
Office Hours:	T 10:00 am - 12 noon T 1:00 pm - 3:00 pm **held in Hugel 125*

Contact Information

Professor:	Christopher Hawley
Office:	Hugel Science Center 024
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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

- understand, identify, and apply the fundamental principles of mechanics in a variety of physical situations
- apply qualitative and quantitative problem-solving skills to answer concrete questions and communicate your reasoning to others
- describe phenomena in the physical world using the language of mathematics including calculus concepts and vector quantities
- identify conserved quantities in a physical system and apply the corresponding conservation laws to extract information about that system
- engage in the process of *doing* physics, including such tasks as developing, testing, and evaluating models, graphing and interpreting experimental data, solving problems, and communicating results
- 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

Prerequisites MATH 161 or permission of instructor

Course Text

University Physics with Modern Physics with *Modified Mastering Physics*, 15th ed.
by Hugh Young and Roger Freedman

*If you did not purchase *Modified Mastering Physics* with the text, you can buy it online at http://www.MasteringPhysics.com/

Course Policies Attendance is mandatory and I encourage you to read the relevant sections of the text (as listed in the schedule) *before* class so that the material is not completely unfamiliar to you when we start discussing it together. A significant component of this course will involve in-class participation and in-class group problem solving; these activities are designed to help you better learn the material and, as such, require your presence in order to be effective. Working with 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.

There will be a sign-in sheet at the beginning of each class meeting to help track attendance; please fill it out upon entering class. Excused absences (accompanied by a Dean's Excuse) will not be marked down.

Grading Grades are determined on the following basis:

Participation:	10%	Mid-term Exam I:	13.75%
Labs:	15%	Mid-term Exam II:	13.75%
Problem Sets:	20%	Mid-term Exam III:	13.75%
		Final Exam (2 units):	27.5%

$*$ lowest exam "unit" will be dropped

Each mid-term counts towards an equally weighted "unit" with the final exam counting as two "units." I will drop the lowest "unit" in your final grade. Example 1: If Exam II is your lowest exam grade, it will be dropped from your final grade as though it never happened. Example 2: If your final exam is your lowest exam grade, then it will only count for 1/2 credit (one of the two "units" will be dropped). **You still must take all the exams in the course!** If you skip an exam, that zero will count towards your overall exam grade; only the lowest completed exam "unit" will be dropped.

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 complete all laboratory activities and receive a passing grade for the laboratory part of the course. Further details will be provided by your laboratory instructor.

Problem Sets: Homework will be assigned on a weekly basis and will generally be due on **Wednesdays** at the beginning 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 consist of a selection of online problems available through *Mastering Physics*. See the **Mastering Physics Introduction** on Moodle for more details.

A few notes about assigned problem sets:

- It is in your best interest to keep a homework notebook where you record all of your homework solutions and work through problems just like you would in class or on an exam. Only after completing a homework problem in your notebook should you attempt to submit it online! Your homework notebook will serve as an excellent study tool for exams and if you come to office hours for assistance, I will expect to see your work so that I can help.
- 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.
- 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).
- Some tips and pointers for doing problem sets that will help keep your work clearly and logically organized are below. These steps are not required, but I guarantee that you will find your work easier to follow, explain to others, and learn from if you adhere to these suggestions.
  - 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. Solutions 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 for you to follow your own work when you look it over.
  - Think about or comment on the significance of your answer. (Does it make sense? Is it what you expected? Why or why not?)
  - 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, even with online assignments.

Exams There will be three in-class exams and a comprehensive final. For each exam, I will provide you with an equation sheet which will be made available shortly 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 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 in-class examples, problems in the text, 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 and work through book examples.

Academic Honesty I expect that you will abide by the "Principles of Intellectual Honesty" appearing in the Lafayette College Student Handbook. Posting homework or exam questions to an external site without my permission is a violation of the Academic Honesty Policy. The Physics department also has an Academic Honesty policy for rules regarding collaboration with others. This document is available on the Moodle page for this class. Please feel free to ask if you have any questions about this policy.

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.

Proper Usage of Course Materials & Classroom Recordings At Lafayette College, all course materials are proprietary and for class purposes only. This includes posted recordings of lectures, worksheets, discussion prompts, and other course items. Reposting such materials or distributing them through any means is prohibited. Such materials should not be reposted or distributed through any means. You must request my permission prior to creating your own recordings of class materials, and any recordings are not to be shared or posted online even when permission is granted to record. If you have any questions about proper usage of course materials please ask me. Please also be in contact with me if you have any concerns with being recorded during the course.

COVID-19 Mask Policy Wearing a mask is known to reduce the transmission of SARS-CoV-2, the virus responsible for COVID-19. Regardless of your vaccination status, to protect the health of our class, the College policy is that masks must be worn during all indoor class sessions. Masks should be worn properly over the nose and mouth and secured on the chin. No food is permitted inside the classroom. You may temporarily unmask in order to take a drink. Students who show up to class without a mask will be asked to return to class wearing one in order to protect the health of our classroom community. In the event that you do not have access to a mask to wear during the class session, please let me know and I will make sure that you are able to obtain one.

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:

- NS 1: Employ the fundamental elements of the scientific method in the physical and natural world by identifying and evaluating a testable scientific hypothesis.
- NS2: Create and evaluate descriptions and representations of scientific data via equations, graphs, tables, and/or models.

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.

Tentative Lecture Schedule and Associated Readings

Jan. 24	Introduction	Ch. 1:1-2	
Jan. 26	Units, Velocity, & Uncertainty	Ch. 1:3-6	
Jan. 28	Working with Vectors	Ch. 1:7-10	
Jan. 31	Position, Velocity, and Acceleration	Ch. 2:1-3	
Feb. 2	Motion with Constant Acceleration	Ch. 2:4	PS 1 due
Feb. 4	Falling Motion	Ch. 2:5-6	
Feb. 7	Free Fall, Motion in Two and Three Dimensions	Ch. 3:1-2	
Feb. 9	Projectile Motion	Ch. 3:3	PS 2 due
Feb. 11	Projectile Motion Part II	Ch. 3:3	
Feb. 14	Force and Newton's Laws	Ch. 4:1-2	
Feb. 16	Newton's Laws Part II	Ch. 4:3-4, 6	PS 3 due
Feb. 18	Newton's Laws Part III	Chs. 5:1-3	
Feb. 21	Newton's Laws Part IV	Ch. 4:5	
Feb. 23	Circular Motion	Chs. 3:4, 5:4	PS 4 due
Feb. 25	**Exam 1**	Chs. 1-5	
Feb. 28	Work and Kinetic Energy	Ch. 6:1-3	
Mar. 2	Work and Power	Ch. 6:4	PS 6 due
Mar. 4	Work, Power, and Energy	Ch. 6:4	
Mar. 7	Potential Energy: Applications	Ch. 7:1	
Mar. 9	Energy Problems	Ch. 7:2	PS 7 due
Mar. 11	Forces and Potential Energy	Ch. 7:3-5	
Mar. 14	**no class** (Spring Break)	-	
Mar. 16	**no class** (Spring Break)	-	
Mar. 18	**no class** (Spring Break)	-	
Mar. 21	Momentum and Impulse	Ch. 8:1-2	
Mar. 23	Momentum Conservation, Elastic & Inelastic Collisions	Ch. 8:3	PS 8 due
Mar. 25	Elastic & Inelastic Collisions continued	Ch. 8:4	
Mar. 28	Center of Mass	Ch. 8:5	
Mar. 30	Introduction to Rotation	Ch. 9:1	PS 9 due
Apr. 1	**Exam 2**	Chs. 6-8	

Apr. 4	Rotational Kinematics	Ch. 9:2-3	
Apr. 6	Energy of Rotation & Moments of Inertia	Ch. 9:4	
Apr. 8	Evaluating Moments of Inertia	Ch. 9:5-6	PS 10 due
Apr. 11	Torque	Ch. 10:1-2	
Apr. 13	Angular Dynamics Problems	Ch. 10:3	PS 11 due
Apr. 15	Angular Momentum	Ch. 10:4-5	
Apr. 18	Conservation of Angular Momentum	Ch. 10:6	
Apr. 20	Rotational Motion Problems	Ch. 10:6-7	PS 12 due
Apr. 22	Simple Harmonic Motion: Part I	Ch. 14:1-3	
Apr. 25	Simple Harmonic Motion: Part II	Ch. 14:4-6	
Apr. 27	Wave Properties: Part I	Ch. 15:1-3	PS 13 due
Apr. 29	**Exam 3**	Chs. 9-10	
May 2	Wave Properties: Part II	Ch. 15:3-5	
May 4	Superposition and Interference	Ch. 15:6	
May 6	Standing Waves	Ch. 15:7-8	PS 14 due

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