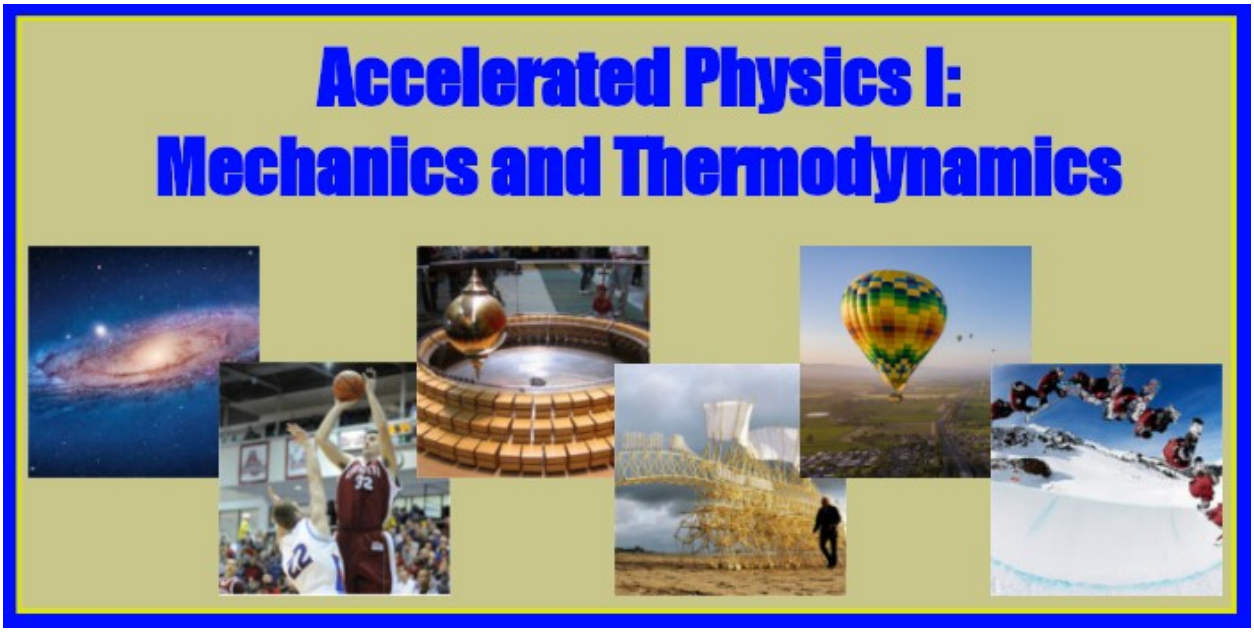

Accelerated Physics I:
Mechanics and Thermodynamics (PHYS 151)
Fall Semester, 2024

Instructor:

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General Course Information

This is the first course in an accelerated two-semester introductory sequence in physics designed primarily for students who intend to major in physics and/or engineering and who already have some physics background. In this first semester, we will focus primarily on classical mechanics – the study of Newton's laws of motion and how they can be applied to describe and predict how everyday objects (and also some not-so-everyday objects) move and interact with each other. We will also examine a variety of topics in thermodynamics – the study of the energy associated with the random motion of particles in a system and how that energy can be transferred to and from that system's surroundings. Over the course of the semester, we will be introduced some of the most fundamental concepts in physics – concepts such as energy, momentum, force, and power – and examine the relationships between them. The material that we cover in this course forms the foundation of not only physics, but of chemistry, biology, geology, and every other field of natural science or engineering.

The understanding that you take away from this course will therefore provide you with a deeper understanding and appreciation of how the things we observe in nature and in our daily

lives work at the most basic level. In the process of coming to that understanding, you'll get a chance to hone some of the universal skills that are crucial in practically *any* science or engineering field – skills such as setting up an experiment, thinking critically about what you observe, reasoning through problems, and communicating your own knowledge to others. Indeed, by the end of the semester, you can look forward to being able to do all of the following.

- You'll be able to understand and apply the fundamental principles of mechanics – and especially **Newton's laws of motion** – in a variety of physical situations.
- You'll be able to identify conserved quantities in a physical system and apply the corresponding **conservation laws** in order to extract information about that system.
- You'll be able to **describe natural phenomena using the language of mathematics** – including calculus concepts and vector quantities.
- You'll be able to apply both qualitative- and quantitative-reasoning skills toward solving concrete problems, but also to communicate the reasoning behind your solutions to others.
- You'll be able to **perform experimental measurements** relevant for testing a hypothesis and to evaluate whether your data supports, motivates the revision of, or refutes that hypothesis.
- You'll be able to interpret, create, and describe **graphical representations of data**.

The prerequisites for this include an understanding of calculus at the level of Math 161, as well as basic algebra and geometry. You should be aware that calculus is an integral part of this course (no pun intended), and that a solid grasp of these mathematical prerequisites is assumed. Understanding this background material will be your responsibility, and if you don't feel comfortable with this material, it's up to you to seek help from the instructors or from elsewhere.

I ask that you join this course with a will to think, to ask questions, to make mistakes, and to try out ideas. Be careful not to confuse understanding with having memorized a lot of facts and formulas. I feel that the former is important while the latter is not – and the former will be far more useful to you in the long run.

Components of the Course

The course will consist of class meetings, reading assignments in the text, some questions and problems, some laboratory experience, three mid-term exams, and a final exam. These are described more fully below.

Class Meetings:

Class meetings will be held **from 9:30 – 10:20 AM in Hugel 142** each Monday, Wednesday, and Friday during the semester. A schedule of the topics we'll be discussing at each class meeting, along with the corresponding reading assignments, can be found on the course web page. These class meetings are there to help clarify things that you might be confused about after exerting your best efforts at understanding them on your own. However, I emphasize that **not everything can be covered in class; you are responsible for understanding much of the**

material on your own by synthesizing what you've learned from your readings, problem sets, lab experiments, exams, and other class activities. It is therefore important that you come to class prepared to ask questions. There are no "dumb" ones. If you don't understand something, chances are there are others who don't understand either or who don't even realize they are missing something.

Class meetings aren't only about lectures either: on most days, we will also have other class activities that are meant to help you understand the material. For example, during class meetings, you will often be working collaboratively on problem-solving activities with your peers. These kinds of activities are designed provide you with an opportunity to apply what you're learning in ways that more authentically mirror how practicing scientists and engineers actually work. Moreover, it is not unusual for test questions to be based on these activities, so make sure you understand them. For all of these reasons, **regular attendance in class is expected**. You are responsible for knowing anything covered in class, even if you have to miss class for any reason.

Readings:

The required textbook for this course is

- Hugh D. Young and Roger A Freedman, *University Physics with Modern Physics with Mastering Physics,* 15th Ed. (Pearson, 2019).

Readings from the textbook will be assigned for each class meeting, and it is important to do the assigned reading before class. You can't speed-read this stuff; you should go through it with pencil and paper at hand, checking it out as you go.

In addition to the textbook, you will also need to acquire an **access code for Mastering Physics**. If you purchase the textbook new from the Lafayette College Store, you will automatically be given an access code. If you choose to acquire the textbook in another way, you may purchase an access code online from Pearson Publishing at https://mlm.pearson.com. The course ID for this section of PHYS 151 is thomas50466.

Homework Assignments:

Homework assignments for this course will include both online exercises from Mastering Physics and problem sets that you are to submit on paper. A list of the problems included in each homework assignment will be accessible from the course web page. **All problems are due at 4:00 PM on the day (typically a Wednesday) indicated on the course schedule** on that same web page. I will accept late paper-and-pencil exercises for half credit up until 48 hours after the time it is due; whereas the credit given for Mastering-Physics exercises will gradually decrease to zero over a 48 hour period beginning at the time it is due. Late homework will not be accepted beyond that point without a Dean's Excuse.

Working through problems accomplishes a lot of different things: it gives you practice using the physical principles you're studying, which helps you learn them in a way simple memorization doesn't; it can show you some further interesting consequences of the fundamental ideas; it will teach you how to approach problems; and it will help you discover how well you really understand what you have read. It is essential that you read the relevant sections of the textbook and review your lecture notes thoroughly *before* attempting the homework problems.

Almost all the physics in a problem comes at the beginning, in the process of setting up

the problem – you need to understand the physical principles that apply prior to solving the problem. This means you need to think about the physics, not search for the "right equation" – often there *is* no "right equation." The important thing is *not* getting the same numerical answer as in the back of the book, but understanding the physical concepts and how to apply them! In fact, many times, it is a good idea to try and answer the question *qualitatively* prior to plugging numbers into equations. It is also a good idea, once you think you've solved a particular problem, to ask whether your solution seems reasonable – if you have no idea, it probably means that you haven't really understood the problem.

You are encouraged to work on homework problems with other students in the class. This can be a very productive way to study, and working with other people to solve problems is a big part of how science and engineering are really done. However, your written work should reflect your own understanding and not be a copy of another person's efforts.

Mid-Term Exams and Final Exam**:**

There will be two mid-term exams given during the course. You will take each of these exams during your designated lab period. The first exam will take place **on Monday, Feb. 19th or Tuesday, Feb. 20th**, depending on the section of PHYS 151L in which you are enrolled, and the second will take place **on Monday, Apr. 8th or Tuesday, Apr. 9th**. These exams are designed give you the opportunity to demonstrate how well you understand the material. The mid-term exams will focus primarily on material covered since the previous exam (or in the case of the first exam, since the beginning of the course); however, each new topic introduced in this course builds incrementally upon the material we'll have studied previously. In addition, there will also be a final exam at a date and time to be determined by the Registrar.

Laboratory:

You will be performing a variety of laboratory experiments over the course of the semester. These labs are an integral part of this course. Physics is an experimental science and did not really get started in its modern form until people began to do careful, quantitative experiments. The physics lab is a place to test and develop your understanding of the physics you learn in the classroom. Not only is it a chance to see if the ideas being presented are actually true, but it also gives a nice glimpse of how scientific information – and confidence in that information – is acquired.

Further information about the laboratory portion of this course will be provided by your laboratory instructor during your first lab meeting.

Grading

Course Grade:

Your grade in the course will be determined by the following criteria:

Homework	24%
Labs	20%
Mid-term Exam 1	18%
Mid-term Exam 2	18%
Final Exam	20%

In calculating your homework grade, I will drop the individual homework assignment on which your receive the lowest percentage of possible points.

Instructor Drop-In Hours (a.k.a. "Office Hours"):

Drop-in hours are blocks of **time that I set aside specifically for you** and for other students in classes that I am currently teaching – they are times during which, for example, you can ask me to go over concepts that we've been studying in class again, get homework help, or ask me questions about any other aspect of the course. Sometimes these blocks of time are referred to as "office hours," but in this case, this is a misnomer because they will be held not in my office, but rather in Hugel 125. My drop-in hours this semester will be held on **Mondays from 3:00 – 4:00 PM**, on **Wednesdays from 1:30 – 3:30 PM**, and on **Fridays from 1:00 – 2:00 PM** unless otherwise noted on the course web page. If you and other students in the course have the same question, you are welcome – and in fact encouraged – to meet with me during my drop-in hours as a group.

The default assumption is that my drop-in hours will take place in person. However, if the need arises for you to attend drop-in hours virtually at any point during the semester (e.g., because of a winter-weather emergency or because you are isolating due to COVID-19), please email me in advance to schedule a virtual drop-in-hours meeting. Such meetings will take place over my drop-in-hours Zoom link, which is

- https://lafayette.zoom.us/j/99772595796

The password is provided on the course Moodle.

If you are unable to make it to these official drop-in hours either virtually or in person, you may also email me to make an appointment to meet at some other time. However, I recommend that you do this as far in advance as possible in order to ensure that we can find a time to meet.

Intellectual Honesty:

All exams and quizzes in this class are closed-book. Calculators are permitted, including graphing calculators (e.g., calculators similar to the Texas Instruments TI-84), but the use of cell phones and cell-phone-based calculator-emulator apps is not permitted on exams or quizzes. You will also be provided with a sheet of useful equations and fundamental constants at the start of each exam. However, the use of any other resources is not permitted. When studying, working in the laboratory, or working on homework problems, I encourage you to work with other students. However, you may not consult a solutions manual or any other source for answers to the problems, and the write-up that you submit to me for each problem should be your own work.

One of the goals of this class is to help you develop your own intuition about how to apply your physics knowledge in practice. For this reason, the use of tools based on generative artificial intelligence (AI) when working on homework problems and taking exams is prohibited in this class (with exceptions made for rudimentary tools associated with basic text-autocorrect or search-engine functionality). The use of such tools is also prohibited during the laboratory component of this course. However, if you believe that other applications of tools based on generative AI will help further your learning in this course, you should feel free to make use of

them in those capacities.

As always, you are expected to abide by the principles of intellectual honesty and academic integrity outlined in the Lafayette Student Handbook, which can be found at

- https://conduct.lafayette.edu/student-handbook/

Other Useful Information

Student Academic Resources Site:

This is a centralized website for Lafayette students which contains resources related to college-transition support, accessibility services, tutoring, health and well-being, advising and registration, technology help, library services, student funds, and more. A link to the site is provided below

https://spaces.lafayette.edu/enrol/index.php?id=1276

You are encouraged to self-enroll in this site and to bookmark it for future reference.

Accessibility Services:

In compliance with Lafayette College policy and equal access laws, I am available to discuss appropriate academic accommodations that you may require as a student with a disability. If you are requesting accommodations, you must register with the Disability Services Office (administered by the Academic Resource Hub) for disability verification and for the determination of reasonable academic accommodations. It is **your responsibility** to provide me with an official letter from Disability Services which clearly outlines what those accommodations are. I cannot provide accommodations until you provide me with such a letter. Requests for academic accommodations must be made within the first two weeks of the semester, except in unusual circumstances, so that suitable arrangements can be made in a timely manner.

Informal Surveys:

Over the course of the semester, I want to hear from you how you feel the course is going, what you like, what you don't like, what your concerns are, and how you think the course could be improved. Therefore, at regular intervals throughout the semester, you'll have the opportunity to fill out a short, informal course evaluation so that we can get feedback from you.

Course Communication:

This syllabus, a list of assigned readings and problem sets, and other course materials will be posted on the course web page, which can be found at

- https://workbench.lafayette.edu/~thomasbd/Phys151-AcceleratedIntroMechanics-Spring-2024/Phys151-AcceleratedIntroMechanics-Spring-2024.html

In addition to the course web page, there is also a Moodle page for this course which I will frequently use in distributing course materials, communicating with the class, etc. The Moodle

page can be found at

- https://moodle.lafayette.edu/course/view.php?id=27045

Occasionally, it may be necessary for me to communicate additional information (scheduling changes, clarifications about homework problems, etc.) to the class as a whole. When I do so, I will use your official Lafayette email addresses for all course-related correspondence, so make sure to check your Lafayette email regularly.

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 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.

COVID-19 Protocols:

Masking is not required during class meetings or during my instructor drop-in hours this semester under normal circumstances. That said, I will be wearing a mask in the classroom at all times, and I encourage you to do likewise if it makes you feel more comfortable. If you choose to wear a mask, I strongly recommend wearing a tightly fitting N95 (or KN95) respirator rather than a cloth mask or surgical mask in class, since such respirators provide a far higher level of protection.

If you are experiencing COVID-19 or flu symptoms (cough, chills, fever, sore throat, etc.), inform me of the situation by email and get a COVID-19 test as soon as possible. If the test is negative, you may attend class meetings and instructor drop-in hours, but you **are required to wear a mask** while your symptoms persist (these tests have a high false-negative rate, and masks help reduce the transmission of other viruses as well). If the test is positive, you are required by Lafayette College protocols isolate for 5 days and may not attend class meetings or instructor drop-in hours until the isolation period is over. You are also required to wear a mask for an additional 5 days after this isolation period ends. If you test positive for COVID-19, inform me immediately so that we can discuss how you will keep up with your work in this class during the isolation period.

In the event that any member of the class adamantly refuses to abide by these safety protocols during any class meeting, class will be canceled effective immediately. The Dean of Students will be notified and all members of the class will receive instructions by email as to how and when we will make up for the rest of that class meeting.

Contingency Procedures for Virtual Class Meetings:

The default expectation is that all class meetings this semester will be held in person in Hugel 142. However, under certain circumstances, we may temporarily be compelled to move those meetings online. Those circumstances include the following:

- Your instructor is quarantining or in isolation
- A substantial fraction of the class is quarantining or in isolation
- There is a winter-weather emergency

I will notify all members of the class by email as far in advance as possible if we need to switch to a virtual classroom environment at any point during the semester. This may not be an infrequent occurrence, so please check your email regularly. The Zoom link that we will use for remote class meetings is

- https://lafayette.zoom.us/j/99942989789

The password is provided on the course Moodle. The assumption is that whenever this occurs, we will return to an in-person learning environment as soon as circumstances permit.

If we are ever temporarily forced to move to a virtual format, I would like us to be able to simulate the atmosphere of a physical classroom to whatever extent we can. For this reason, I would like to ask that you have your camera on during any virtual class meetings we end up having and to use the "gallery view" option on Zoom so that we can all see each other and respond to each other's visual cues. I will do the same. That said, if there are extenuating circumstances which would make having your camera on an issue for you, please reach out to me and we will work out an equitable solution. Please mute yourself when you are not speaking in order to reduce background noise. Please raise your actual hand in order to take part in the discussion. If I do not see your actual hand, please raise your "digital hand."

Privacy Statement Concerning Course Materials and 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. Permission will be granted only when sanctioned as an academic accommodation in an official letter from the Accessibility Services Office. 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.

Online discussions in Moodle occurring during synchronous class sessions should also remain private and not be shared outside of the course. Courses using Moodle will make student information visible to other students in this class. Student information in courses is protected by the Family Educational Right to Privacy Act (FERPA). Disclosure of student information to unauthorized parties violates federal privacy laws and it must not be shared with anyone outside the class. Questions can be referred to the Registrar's Office.

Mandatory Credit-Hour Statement:

The student work in this course is in full compliance with the federal definition of a four-credit-hour course. The full policy and practice statement can be found on the Registrar's Office website at

- https://registrar.lafayette.edu/wp-content/uploads/sites/193/2022/07/Federal-Credit-Hour-Policy-Web-Statement.pdf

Winter-Weather Emergencies:

You should assume that class meetings will occur as usual, despite any weather-related issues (including power outages), even if campus offices open late or close early. In the rare event that class must be canceled, I will notify the class by email, and by leaving a voicemail message on my office phone, the number for which is (610) 330-5207.

In Closing

If you have any questions about this syllabus, or about any aspect of the course, please don't hesitate to contact me. By the end of this semester, you can look forward to having both a better understanding of *why* things in the natural world behave the way they do and a practical grasp of *how* to apply fundamental physics principles toward solving the kinds of problems that scientists and engineers grapple with every day of their lives.

Course Schedule

The full, up-to-date schedule for the course, including due date for all assignments is available on the course web page.

Week	Topics and Readings	Due Dates
Week 1 1/22 – 1/26	**Motion in One Dimension** Young & Freedman: 1.1 – 1.10, 2.1 – 2.3	HW1 (Due 1/26)
Week 2 1/29 – 2/2	**Motion in Two and Three Dimensions** Young & Freedman: 2.4 – 2.6, 3.1 – 3.3	HW2 (Due 1/31)
Week 3 2/5 – 2/9	**Forces and Newton's Laws** Young & Freedman: 4.1 – 4.4, 4.6, 5.1 – 5.3, 6.3	HW3 (Due 2/7)
Week 4 2/12 – 2/16	**Circular Motion and Gravity** Young & Freedman: 3.4, 4.5, 5.4, 13.1 – 13.2	HW 4 (2/14)
Week 5 2/19 – 2/23	**Work and Energy** Young & Freedman: 6.1 – 6.3, 7.1	HW5 (Due 2/21) Midterm I (2/19 – 2/20)
Week 6 2/26 – 3/1	**Conservative Forces and Potential Energy** Young & Freedman: 7.2 – 7.4, 13.3 – 13.4	HW 6 (Due 2/28)
Week 7 3/4 – 3/8	**Momentum** Young & Freedman: 6.4, 8.1 – 8.3	HW7 (Due 3/6)
Week 8 3/11 – 3/15	**Spring Break** (No classes)	
Week 9 3/18 – 3/22	**Collisions and Center of Mass** Young & Freedman: 8.4 – 8.4, 9.1 – 9.2	HW 8 (3/20)
Week 10 3/25 – 3/29	**Rotational Motion** Young & Freedman: 9.3 – 9.6	HW 9 (Due 3/27)
Week 11 4/1 – 4/5	**Torque and Angular Dynamics** Young & Freedman: 10.1 – 10.5	HW 10 (Due 4/3)
Week 12 4/8 – 4/12	**Equilibrium and Oscillations** Young & Freedman: 10.6 – 10.7, 14.1 – 14.6	HW 11 (Due 4/11) Midterm II (4/8 – 4/9)
Week 13 4/15 – 4/19	**Waves** Young & Freedman: 15.1 – 15.8	HW 12 (4/17)
Week 14 4/22 – 4/26	**Fluid Mechanics** Young & Freedman: 12.1 – 12.1, 18.1 – 18.4	HW 13 (Due 4/24)
Week 15 4/29 – 5/3	**Thermodynamics** Young & Freedman: 18.5, 19.1 – 19.5, 19.8	HW 14 (Due 5/3)
Final Exam Week		Final (TBA)