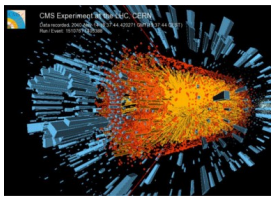
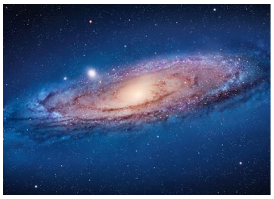
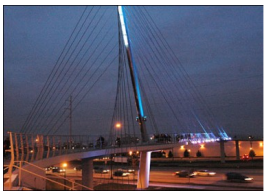





Physics 131-04
Physics I: Mechanics

Spring Semester, 2023






Instructor:

Brooks Thomas
Email: thomasbd@lafayette.edu
Office: Hugel 020
Phone: (610) 330-5207

General Course Information

This is the first course in a two-semester introductory sequence in physics for students who plan to major in the physical sciences or to enter an engineering program. 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. 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 2:10 – 3:00 PM in Hugel 100** 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 in teams of two or three people to come up with solutions to more open-ended problems, such as evaluating a set of proposals for a hydroelectric plant or optimizing the design for a circuit. 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 a**n 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 131 is thomas92300.

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.

Course Reflections and Comprehension Quizzes:

What's the best way to learn physics? That's a tricky question. In fact, there's a whole subfield of physics called Physics Education Research (PER), which is devoted to studying how people learn physics. The best way to learn differs from person to person, but there are some strategies that research has shown in general to be a lot more effective than others. The important thing is to experiment with different strategies, and to take time to reflect on what works for you and what doesn't. To sweeten the deal, I'll be providing you with a number of opportunities to make up for points lost on homework assignments or comprehension quizzes by engaging in some of the activities that research has shown to be particularly effective. In the same spirit, roughly once every two weeks, at the beginning of class, you'll be asked to reflect on what you've learned in this course, identify any concepts you still feel you're struggling with, and articulate a concrete plan for how you'll improve your understanding of those concepts going forward. These written **course reflections** will contribute to your course grade, so it's important to treat them seriously. The dates of these course reflections won't be announced beforehand, so make sure you arrive promptly at the beginning of class each day.

Furthermore, roughly once a week, at the beginning of class, there will also be a **short comprehension quiz** on some of the recent material we've been covering in class and on homework assignments. These quizzes are intended both to help you to check your own understanding of that material and to alert me if there are any concepts with which a lot of the class is struggling so I can better address them. The dates of these quizzes won't be announced beforehand, so make sure that you arrive in class each day prepared. Each quiz will begin **promptly at 2:10 PM** and **you'll only have until 2:20 PM to complete it** no matter when you start taking it, so make sure you arrive in class on time. Your lowest quiz grade will be dropped at the end of the semester.

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

There will be two mid-term exams given during the course: **one on Friday, Feb. 24th and one on Friday, Apr. 7th**. 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	20%
Comprehension Quizzes and Course Reflections	10%
Labs	20%
Mid-term Exam 1	15%
Mid-term Exam 2	15%
Final Exam	20%

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 not be held in my office. Instead, in order to minimize the risk of COVID-19 transmission, they will be held in Hugel 125, which is a better ventilated room equipped with a HEPA filter. My drop-in hours this semester will be held on **Mondays from 3:00 – 4:00 PM, Wednesdays from 11:00 AM – 12:00 noon, Thursdays from 11:00 AM – 12:00 noon**, **and Fridays from 11:00 AM – 12:00 noon** unless otherwise noted on the course web page. Alternatively, if you feel more comfortable attending drop-in hours virtually, I will also have a Zoom meeting open during each of the time windows specified above. The link for this drop-in-hours Zoom meeting is

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

The password is provided on the course Moodle. If I am meeting with another student – either in person or virtually – at the time you join this Zoom meeting, you may be placed in the waiting room for a bit before I am able to meet with you. However, if you and other students in the course have the same question, you can certainly meet with me as a group – and this applies to in-person drop-in-hours meetings as well.

If you are unable to make it to these official instructor 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. Please also be aware that my protocols for conducting drop-in hours may change

depending on the manner in which the situation with the COVID-19 pandemic evolves over the course of the semester. If they do change, I will inform the class of these changes by email.

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.

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

Supplemental Instruction:

A number of Supplemental Instruction (SI) leaders have been appointed for different sections of this course. Throughout the course, the SI leaders will lead formal review sessions and provide drop-in tutoring support for students in this course. **You are strongly encouraged to take advantage of this free resource**, and you are welcome to attend both the formal review sessions and drop-in tutoring sessions led by the SI leader for **any section** of Phys 131. The tutoring schedule for all SI leaders will be made accessible both on the course web page and on the course Moodle page.

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/Phys131-IntroPhysicsMechanics-Spring-2023/Phys131-IntroPhysicsMechanics-Spring-2023.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=24638

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.

Other Sections:

There are five sections of Physics 131 being taught this semester by four different professors. The coverage of topics will be similar. However, exams will differ between sections, homework assignments (while they will be quite similar) may differ slightly, and course policies and teaching styles may vary. Nevertheless, those of us teaching the course will work hard to ensure that grading and workload are equitable across all five sections. If you need to switch lecture sections, you should do so as soon as possible. See one of the Phys 131 instructors. A drop/add form must be filed. Changes can only be made for compelling reasons (e.g., a conflict with another class or other college activity). If you need to switch lab sections, contact Physics Lab Coordinator Scott Shelley at shelleys@lafayette.edu.

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:

In order to minimize the risk of COVID-19 transmission during class meetings, strict protocols will be followed. These requirements apply throughout the semester, regardless of what campus protocols happen to be in force at any given time. The default protocol is that any person present in the classroom during class meetings is **required to wear a mask at all times**, beginning from the moment that person enters the classroom. That mask must fit the wearer's face tightly and **cover the wearer's nose and mouth**. If your mask does not fit these criteria, you will be instructed to the classroom until you have acquired a mask that does. I urge all members of the class to wear a tightly fitting N95 or KN95 respirator rather than a cloth mask or surgical mask in class meetings whenever possible. A cloth mask provides only limited protection, and a surgical mask provides only marginally better protection than a cloth mask. By contrast, an N95 or KN95 respirator, when worn properly, provides a significant degree of protection both to you and others around you. I will be wearing an N95 mask in the classroom at all times. These same protocols **also apply during my instructor drop-in hours**.

If you are experiencing COVID-19 symptoms and there is not a compelling alternative explanation for those symptoms (e.g., you feel fatigued because you stayed up all night working on a problem set), do not come to class meeting. Instead, inform me of the situation by email and get a COVID-19 test as soon as possible. If the test result is negative, you may attend subsequent class meetings. If the test results is positive, you are required by Lafayette protocols to isolate and may not attend class meetings until the isolation period is over. If this should occur, inform me immediately so that we can discuss how you will keep up with your work in this class during the isolation period. If you are experiencing COVID-19 symptoms and have not yet received your test result, or if you are isolation, you may attend instructor drop-in hours virtually, but not in person.

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 100. 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/91365075197

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

- http://registrar.lafayette.edu/additional-resources/cep-course-proposal/

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 1/23 – 1/27	**Units and Vectors** Young & Freedman: 1.1 – 1.10	HW1 (Due 1/27)
Week 2 1/30 – 2/3	**Motion in One Dimension** Young & Freedman: 2.1 – 2.6	HW2 (Due 2/1)
Week 3 2/6 – 2/10	**Motion in Two and Three Dimensions** Young & Freedman: 3.1 – 3.3, 4.1 – 4.2	HW3 (Due 2/8)
Week 4 2/13 – 2/17	**Forces and Newton's Laws** Young & Freedman: 4.3 – 4.6, 5.1 – 5.3, 6.3	HW 4 (2/15)
Week 5 2/20 – 2/24	**Circular Motion** Young & Freedman: 3.4, 5.4, 13.1 – 12.2	HW5 (Due 2/22) Midterm I (2/24)
Week 6 2/27 – 3/3	**Work and Energy** Young & Freedman: 6.1 – 6.3, 7.1	HW 6 (Due 3/1)
Week 7 3/6 – 3/10	**Conservative Forces and Potential Energy** Young & Freedman: 7.1 – 7.4, 13.3 – 13.4	HW7 (Due 3/8)
Week 8 3/13 – 3/17	**Spring Break** (No classes)	
Week 9 3/20 – 3/24	**Momentum** Young & Freedman: 6.4, 8.1 – 8.3	HW 8 (3/22)
Week 10 3/27 – 3/31	**Collisions and Center of Mass** Young & Freedman: 8.4 – 8.6, 9.1	HW 9 (Due 3/29)
Week 11 4/3 – 4/7	**Rotational Motion** Young & Freedman: 9.2 – 9.4	HW 10 (Due 4/5) Midterm II (4/7)
Week 12 4/10 – 4/14	**Torque and Angular Dynamics** Young & Freedman: 9.5 – 9.6, 10.1 – 10.3	HW 11 (Due 4/12)
Week 13 4/17 – 4/21	**Angular Momentum** Young & Freedman: 10.4 – 10.7, 14.1 – 14.3	HW 12 (4/19)
Week 14 4/24 – 4/28	**Oscillations and Waves** Young & Freedman: 14.4 – 14.6, 15.1 – 15.4	HW 13 (Due 4/26)
Week 15 5/1 – 5/5	**Wave Motion** Young & Freedman: 15.5 – 15.8	HW 14 (Due 5/5)
Final Exam Week		Final (TBA)