

# Physics & Astronomy 224 – Fundamentals of Physics II Lab – S

## Fall Semester 2024 – 1 Credit Hour

### Online Learning

## Instructors

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## Quick read

This class is entirely online. Your work will be at your own pace whenever you want to do it since there are no scheduled class times. However the course has weekly assignments which are required. See the sections below about how to begin your class.

This physics lab class has teaching assistants who help me with grading and who will also will help you if you need assistance. When their contact information is available it will be added to the Blackboard site as well. There is a discussion forum on our class website where questions should be asked and answered. When you need individual assistance try University email rather than a phone call, and always put the course name “224-50” on the subject line. While phone calls and video conferences are other options, email is the best one for us if it works for you.

Go to Blackboard and check out “Start Here” to have access to class content online. There is a lab activity each week based on this content, and work to do and submit on Blackboard. You will receive email reminders when it is due. Use the Blackboard discussion group. We watch that, can offer advice or answer questions, and you get credit for participation too. For the rest, skip to the **Requirements** below, or read on for the details.

## Objectives

Physics is the foundation of the sciences that enable us to understand the universe on the largest and smallest scales, from the beginning of time to its uncertain future. It is also the practical basis of contemporary technology, engineering, medicine, and biology.

In this lab, the second of a two-semester sequence on the fundamental concepts and methods of physics, we will explore how physics works, learn the necessary math concepts to use it, and apply it to electricity, magnetism, light, quantum mechanics and relativity through laboratory experiments, simulations, and analysis of real data.

The objective of this course is to provide experience with how physics determines what we can observe, provides the tools to enable improving our understanding of nature, and in turn limits what is observable, measurable, and possibly even knowable. The lab activities, even while virtual and online, will incorporate physics into your critical thinking skills, and develop your ability to understand and solve problems using the fundamental concepts of physics and a reasoned approach that seeks simplification leading to quantitative and intuitive understanding of how nature behaves. This is a pre-professional course and is one of two semesters that together cover much of “classical physics” experiments. We will not ignore the really interesting new developments though, and where it is possible with our resources we will engage the most current aspects of scientific exploration. Our goals are to

- Help you understand (and cope with) physics encountered in everyday life: LED light bulbs, microwave ovens, and car parts.
- Provide a basis for understanding the latest developments about science you will hear in the news: colliding blackholes, global warming.
- Apply physics principles to astronomy, geology, biology, chemistry, medicine, engineering, music, and yes, to cats.
- Recognize that while physics does not explain everything, it does predict observable effects through sometimes intangible, invisible, and not fully understood processes.
- Present you with mysteries not yet solved, perhaps so that you may solve them in the future and win a Nobel Prize giving due credit to your physics class.
- Teach physics that you may apply to make life better for yourself and others now, and in the future.
- Open your mind to new discovery by knowing that the world should be understandable.

## Cardinal Core Outcomes and Assessments

Natural Sciences are concerned with understanding the laws of nature and the physical world. Students who satisfy the Cardinal Core requirement for Natural Sciences will be able to do all of the following:

1. Demonstrate an understanding of the nature and methods of science inquiry.
2. Apply scientific principles: to interpret evidence, to make predictions, and/or to explain cross-cutting concepts in one or more of the sciences.
3. Explain how scientific principles relate to issues of personal and/or societal importance.

4. Communicate effectively an understanding of scientific concepts and experimental outcomes in speech or writing, using sound scientific terminology and citation appropriate to the discipline.

In this course these outcomes will be assessed through weekly assigned activities or experiments. A monitored online forum for class discussion of topics posed both by students and by the instructor will encourage students to develop their knowledge, deeper understanding of the science, and the skills to communicate effectively with others.

### **Outcome 1**

*Demonstrate an understanding of the nature and methods of science inquiry.*

The course covers how we have come to understand the entire universe through physics and emphasizes in this first semester the physics of motion, energy, gravity, heat, thermodynamics and sound. This embodies many of the elements that begin even before written history but continue to this day especially in applications as a basis for atmospheric science, energy generation and Earth's energy balance, space exploration, mechanical and civil engineering, bio-mechanics, and bio-medical devices. A second semester continues with electricity, magnetism, optics, relativity and quantum phenomena. Understanding the roles of individual scientists and their contemporaries, the methods enabling their discoveries, how their knowledge was communicated, and the current process of scientific enterprise, is incorporated into the classes weekly assignments. Additionally, communication skills are refined by the thoughtful questions posed to others in the class that encourage and engage one another in collaborative decisions on how the experiments are done and how data are analyzed.

### **Outcome 2**

*Apply scientific principles: to interpret evidence, to make predictions, and/or to explain cross-cutting concepts in one or more of the sciences.*

While physics is based on observation and measurement, the analysis of the observations leads to a broader understanding of the fundamental natural laws that simplify the apparent complexity of the natural world. This is the essence of experimental science and the the basis for having a laboratory class such as this one. The emphasis in this course is on understanding what those facts tell us about the universe, how we come to those conclusions, and what the uncertainties are in that process. These fundamental ideas of physics unify our understanding of the current state of the universe, and allow us to predict or model its future. Examples will span from our everyday experiences to those we can only imagine.

### **Outcome 3**

*Explain how scientific principles relate to issues of personal and/or societal importance.*

The role of science in modern society is a topic that recurs throughout this class, especially in the context of technology that depends on physics. Contemporary physics uses all the tools at its disposal, including those developed by physics itself. We look at how things work with their dependence on the principles of mechanics, electricity, magnetism, thermodynamics, quantum mechanics and relativity. We may also explore topics of immediate pressing concern as experiments themselves. Examples could be drawn from the measurement and modeling

of pandemics, the Earth's global temperature rise, near Earth objects in our solar system, or the Sun's ultimate aging and demise.

#### **Outcome 4**

*Communicate effectively an understanding of scientific concepts and experimental outcomes in speech or writing, using sound scientific terminology and citation appropriate to the discipline.*

There are required written responses to your work with the lab activities. The topics for these questions are explored in a discussion forum for the class that invites participation by everyone, so that skills to communicate scientific concepts develop during the course when students explain those concepts to one another, and pose questions to their peers. The forum is mentored, and the written responses through submitted reports become part of the class grade.

#### **Requirements**

The class website will guide you through experiments or observations on different weekly topics over the semester, and will pose specific questions to answer. While you may work on these on- or off-line, your responses will be entered online interactively on Blackboard and will be graded. We reserve the right not to accept work that is late, but please let us know when you need extra time.

While you study, you are expected to use the Blackboard discussion forum with other students in the same way that you would work with one another for any class. This is a very important part of the class and we monitor the forum to see where you are having difficulty. We encourage collaboration and peer instruction because our goal is to have you participate in the activities to gain an understanding of the science, and learn by whatever means you find most helpful, but of course you must do your own work. We will try to resolve questions you may have for the class as a whole through the discussion forum whenever we can, and to respond to email individually as needed.

Use the discussion forum, take your time to understand, ask questions when you need help, and remember the objective is to learn how to observe, reason, and use your growing knowledge and skill to solve problems. Individual and group assistance through email, video conferencing, or telephone is available on request.

#### **Blackboard**

The University's Blackboard system is the University's gateway to Distance Education programs:

<https://blackboard.louisville.edu/>

Use your University *User ID* and *Password* to log into Blackboard.

**Start Here** under Course Content provides guidance the first time and will help if you are new to online classes. It includes the syllabus, information about the faculty, and a guide on what to do weekly.

**Announcements** are updated at least weekly with the topic and any new instructions. These are also sent to you by email.

**Assignments** under Course Content is where you submit your work for the week by answering the questions asked there. Each assign is due before Monday midnight of the week following the topic.

**Week One to ...** entries are for each week of the semester with the topic and content for that week. Usually they will take you to our class web server.

**Gradebook** will be updated by Blackboard with assessments of recent work when it is evaluated. Your course grade is the average of all labs. You must participate in the class content before answering the questions that determine your score, and also contribute occasionally to discussions about the assignments. Be sure to stay active in the class by participating in the class website and submitting your work on time for assessment weekly.

**Discussions** is the Blackboard forum for this class.

## Class website

Content for this course is provided through our server that is independent of Blackboard. You should access the server through the weekly links for content on Blackboard. You may notice that you are a guest user, and that for your convenience no login is required at this time. However, Blackboard tracks your access to the content so that we will be alerted if you do not work on the assignments weekly. To avoid issues with your activity in the class, be sure to use your own Blackboard account when working on the course and its assignments.

## Textbook

While the content you need will be provided online through Blackboard, for additional help the recommended free reference for the course is the same one used for our online sections of Physics 221-222.

*College Physics*, Openstax College, 2022

It is made available under the auspices of Rice University and other donors **for free** online at

<https://openstax.org/details/books/college-physics-2e>

Click links on the class website or Blackboard for the interactive version which also supports note-taking, or “Download a PDF” if you prefer a static version on your device or computer. A print version is available through the Openstax site links. This is a comprehensive general college physics textbook that uses algebra. It covers two semesters and has many worked problems and illustrations you will find helpful. Selected readings may be indicated in the on-line website for the class.

In many cases, simply by using Google and looking for an appropriate entry in Wikipedia you can find an answer to basic physics questions, and links to far more detail than most

textbooks provide. If you follow this suggestion, be selective in accepting answers from Internet resources or the current generation of artificial intelligence software (AI, e.g. ChatGPT or Gemini). Wikipedia has proven to be very reliable, as is the Khan Academy and sites supported by NASA. There will be selected links to these resources and others on the class website which you are encouraged to use and share.

Because the class is entirely online, there will be tools available for you that do not require installing software, but you will need Internet access and would benefit from a laptop, Chromebook, or desktop computer for working with the content and completing the assignments.

## Evaluation and Grading

While you will receive email reminders, the course is self-paced. You should plan to complete one experiment each week, and to respond to the weekly lab assignment about that experiment on Blackboard. You may do the work at any time during the week, and you may return to Blackboard's Assignment section to modify your answers until it is finally submitted for our review. Weekly work is usually due by Monday midnight of the following week.

Although the initial scoring of most questions is done in part automatically, there are some that require you to write an answer which we will read and evaluate. Consequently, there will be a delay after you submit your work before we can provide an assessment. If we see an issue about what you have submitted, we may advise changes that would improve your score. Our purpose is to help you learn and understand by observation and reason, not to hear an echo of a precisely "correct" textbook answer. You will have an opportunity after the score is posted to submit a revision. Current assignments and those which remain open for followup work will appear on Blackboard under "Assignments".

**This is very important** – to receive a passing grade, you must participate in the online lab course content weekly, use the discussion forum, and submit your work on Blackboard's Assignments for our assessment. Given that, the average of lab assignments, counting the missed ones as zero, determines the letter grade with A (90 to 100); B (80 to 89); C (70 to 79); and D (60 to 69). We use +/- grades within 2 points of the cuts for the letter grades. For example, 85 would be "B", while 82 would be "B-" and 88 would be "B+".

## Caveats

We reserve the right to make changes in the syllabus when necessary to meet learning objectives, when new physics related discoveries occur, or when there is a technical or software issue that requires a change in content or methodology. Any changes will be announced by email and posted in the current online syllabus and schedule.

## **Title IX/Clery Act Notification**

Sexual misconduct (including sexual harassment, sexual assault, and any other non-consensual behavior of a sexual nature) and sex discrimination violate University policies. Students experiencing such behavior may obtain confidential support from the PEACC Program (502.852.2663), Counseling Center (502.852.6585), and Campus Health Services (502.852.6479). To report sexual misconduct or sex discrimination, contact the Dean of Students (502.852.5787) or University of Louisville Police (502.852.6111).

Disclosure to University faculty or instructors of sexual misconduct, domestic violence, dating violence, or sex discrimination occurring on campus, in a University-sponsored program, or involving a campus visitor or University student or employee (whether current or former) is not confidential under Title IX. Faculty and instructors must forward such reports, including names and circumstances, to the University's Title IX officer.

For more information, see the Sexual Misconduct Guide.

<https://louisville.edu/hr/employeerelations/sexualharassment/procedures/>

## What to do Weekly

- Each Monday begins a new activity for that week with content on the class website.
- Connect to Blackboard and follow the content link to the weekly activity.
- Read the instructions and content on line, work through it at your own pace.
- Ask and answer questions on the discussion forum.
- Before the end of the day at midnight the following Monday, complete the “Assignment” by responding to the item on Blackboard for that week.
- After we have evaluated your work, you may optionally return to it again during the following week to revise and resubmit it.



## Schedule and Content

The primary content is on-line, linked from Blackboard entries. Follow the “What to do weekly” guide above, and check there first for the new material. The topical list here is our current plan for the semester.

**19 August – 25 August** Newton’s physics and gravitational fields and potentials

**26 August – 1 September** Coulomb’s law

**2 September – 8 September** Electrostatic fields and potentials  
*Labor Day*

**9 September – 15 September** Ohm’s law

**16 September – 22 September** Ampere’s force law

**23 September – 29 September** Earth’s magnetic field

**30 September – 6 October** Charge to mass ratio of the electron  
*Midterm break*

**7 October – 13 October** Light, lenses and vision

**14 October – 20 October** Interference and diffraction of waves and light

**21 October – 27 October** Telescopes and light detection

**28 October – 3 November** Optical spectra from atoms, molecules, and blackbodies  
*Presidential election*

**4 November – 10 November** Radioactive decay

**11 November – 17 November** Relativity through time dilation and cosmic rays

**18 November – 24 November** Photoelectric effect

**25 November – 1 December** There is no lab assignment this week  
*Thanksgiving break*

**2 December – 3 December** Last day of classes December 3  
All course work is due Tuesday  
The lab course does not have a comprehensive final