

# Physics & Astronomy 223 – Fundamentals of Physics I Lab – S

## Fall Semester 2020 – 1 Credit Hour

### Online Learning

#### Instructor

John Kielkopf  
Department of Physics and Astronomy  
University of Louisville  
Louisville, KY 40292, USA

University Email: [kielkopf@louisville.edu](mailto:kielkopf@louisville.edu)

Telephone: 502.852.5990

Video Conference: by Zoom or Teams on request

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.

University email is preferable to a phone call, and will provide you with a written response you can save. Please identify the course you are taking in the subject line with “223-50” if the mail is about this class. Video conferences in my “virtual office” are available too, through the Zoom or Teams conferencing systems if you have a microphone and webcam on your desktop computer, an Android cellphone or an Iphone. Please send an email first to set up an appointment and for connection instructions. There is a discussion forum where questions that others may have could be asked. This class also has a teaching assistant who will respond to your reports and who will be able to answer questions about the work. Contact information for the assistant will be posted on Blackboard.

#### 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 first 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 mechanics, heat, and sound 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, measureable, 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, 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 discussion forum on the website 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.

## Websites

The University's Blackboard system is its gateway to this online Distance Education class:

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

Use your University *User ID* and *Password* to log into Blackboard for the quizzes, exams, and announcements. It will take you to other sites with additional content as well.

## Textbook

The content will be provided online through the class website. For additional help, the recommended reference for the course is the same one used for our online sections of Physics & Astronomy 221-222.

*College Physics*, Openstax College, 2016

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

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

Click "Download a PDF" or links on the class website or Blackboard. It is also available in a high quality paper copy through Amazon. This is a comprehensive general college physics textbook that uses algebra.

In many cases, simply by using Google and looking for an appropriate entry in the Wikipedia you can find an answer to basic physics questions, and links to examples and videos that will add to what we offer in selected links on the class website.

Information on useful software and other materials will be provided online. While we are working to provide all content through advanced web-based technology, access to a desktop or laptop rather than a tablet or cellphone may be necessary for some of the required work. If you have problems with class content or on-line software, please use post your questions to the Blackboard Discussion Forum. Often other students have seen the same issue and will know the answer, or if not, we can work together to a solution.

## **Evaluation and Grading**

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 the Assignment page to modify your answers until it is finally submitted. We plan to offer a new experiment or activity each week through the end of the semester. Although the initial scoring of most questions is done automatically, where possible, if we see an issue about what you have submitted, we may ask for you to respond again before we assign a final score for credit. Remember, our purpose is to help you learn and understand by observation and reason, not to hear an echo of a precisely “correct” textbook answer. Your completion of each one contributes equally to the course grade and a missed or skipped quiz will have a significant effect.

We may offer additional 10% for an extra lab if you have time and interest toward the end of the semester in a supplemental experiment. We use this option to help if you have missed one during the term, and to allow development of new activities with your feedback.

We will average all of your work and assign letter grades approximately A (90 to 100); B (80 to 89); C (70 to 79); and D (60 to 69).

## **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.

<http://louisville.edu/hr/employeerelations/sexual-misconduct-brochure>

## 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 assignment 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 end of day the following Sunday, complete the “Assignment” by responding to the item on Blackboard for that week.

## 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 incomplete and will be developed as the semester proceeds. We expect the experiments we offer will closely parallel the content of our online only 221-50 class and may differ somewhat from from the hybrid sections of the lecture class and labs.

**17 August - 23 August** Measurement and statistics

**24 August - 30 August** Experiment with a balance and a pendulum

**31 August - 6 September** Newton’s second law and gravity

**7 September - 13 September** Energy, work, projectile motion, and orbits

**14 September - 20 September** Conservation of linear momentum

**21 September - 27 September** Conservation of angular momentum

**28 September - 4 October** Open week or supplemental friction lab

**5 October - 11 October** Temperature and heat

**12 October - 18 October** Laws governing gases, liquids and solids

**19 October - 25 October** Everyday effects of statistical physics

**26 October - 1 November** Vibrations and waves

**2 November - 8 November** Speed of sound

**9 November - 15 November** Resonances and harmonics in the physics of music

**16 November - 22 November** Open week or supplemental biomechanics lab

**23 November - 29 November** Thanksgiving holiday week.

**30 November - 6 December** Final exam week

This class does not have a final exam.

All supplemental or makeup work if any must be finished by the end of day Saturday.