

Physics & Astronomy 111 – Elements of Physics – B
Fall Semester 2024 – 4 Credit Hours
Online Learning

Instructors

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Quick read

This class is entirely online. It uses content that we provide from our own servers, a free textbook, and the University's Blackboard system for testing and grades. Your work will be at your own pace whenever you want to do it each week. There are no scheduled class times. However, the course has weekly assignments which are required. See the section below about how to begin your class.

This physics class with both “lecture” and lab content has teaching assistants (TAs) who help me with grading and who will also will help you if you need assistance. Our TAs have responsibilities for one or both of these parts of the course. There is a discussion forum on our class website where questions should be asked and where you and your peers may answer or share ideas. When you need assistance and the forum is not helpful, try University email to one of us rather than a phone call, and always put the course name “111-50” 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 work due each week based on this content, and you will receive email reminders when it is due. The class is all about contemporary physics and is meant to be informative and engaging. Use the class website 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

This course meets the University's Cardinal Core Requirements for a three hour Natural Science course with a one hour laboratory.

As with other Cardinal Core Natural Science courses, the objective of this course is to incorporate physics into your critical thinking skills, and to understand how the methods of science work. We will do that by exploring how physics helps us unravel the underlying mysteries of the Universe, and to

1. Teach physics that you may apply to make life better for yourself and others now, and in the future.
2. Help you understand (and cope with) physics encountered in everyday life: LED light bulbs, microwave ovens, and car parts.
3. Provide a basis for understanding the latest developments about science you will hear in the news.
4. Recognize that while physics explains our world astoundingly well, and makes the behavior of gravity, electromagnetism, and the nuclear forces predictable, it relies on concepts we do not yet fully understand. That is, not to fret when something seems incomprehensible, since physics itself has unsolved mysteries.
5. Present you with the latest discoveries, limits of our knowledge, and unsolved problems so that you may solve them in the future and win a Nobel Prize, or have fun trying.
6. 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 online weekly quizzes, lab reports, and two longer tests. A monitored online forum for class discussion of topics posed both by students and by the instructor will encourage you to develop your knowledge, deepen your understanding of the science, and improve your 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. It embodies many of the key discoveries of physical science, even before written history and as recent as this year, that underpin theories of space, time, gravity, motion, electromagnetism, light, entropy, and quantum mechanics. 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 part of the course content and is tested in quizzes and exams. Additionally, thoughtful questions posed to others in the class are encouraged to engage one another in analysis of the topics at hand, and to develop communication skills.

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. 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 span from our everyday experiences to those we can only imagine. They include musical instruments and their sounds, flying airplanes and crashing automobiles, subatomic particles and the one that gives mass to matter, radioactivity and nuclear power, Earth's energy balance and global temperature rise, the fate of the Sun and even of the entire universe, the nature of light and how it propagates, quantum mechanics and what it means for measurement and reality, and of course black holes and ripples in spacetime. This content is included on the weekly quizzes and exams as appropriate for the topics at hand.

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. We look at how things work with their dependence on the principles of mechanics, electricity, magnetism, thermodynamics, quantum mechanics and relativity. We also explore topics of immediate pressing concern such how modern society generates the energy it needs, power from the Sun, and the Earth's global temperature rise. We look beyond Earth to consider space exploration, the physics of interplanetary travel, the discovery of planets around other stars, and how we can use physics to estimate the probability of life elsewhere and the fate of our Earth, the Sun, and the universe. We also look at the ways in which society supports scientific discovery, and the benefits and costs of that enterprise. This content is included on the weekly quizzes and in experiments that add a laboratory component to the class, and is included in the exams.

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 posed questions on the quizzes, responses to the online laboratory experiences, and exams. 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 on quizzes and tests become part of the class grade.

Requirements

Blackboard and the class website will guide you through weekly topics over the semester, and will pose specific ideas and questions to consider. While you study, you are expected to use the 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 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 understand our universe. Individual and group assistance through email, video conferencing, or telephone is available on request.

Each week access the class website through Blackboard (see below) to work with new web-based interactive content, a question to challenge your understanding, an online lab activity, and suggested readings from the textbook. During the week, under Assignments on Blackboard, report on your work with the lab, provide a written response to the question raised in to challenge your understanding, and take a over the week's content. The lab and challenge question assignments are available all week, but the quiz is open any time from Saturday morning through Monday midnight (US Eastern Time). There will be two longer tests, one at midterm, and one at the end of the course. We will send email reminders weekly about the work for the week to help you keep track of what is due.

Blackboard

The University's Blackboard system is its gateway to support for all of its classes:

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

Use your University *User(Elements of Physics* for the latest announcements, links to new content and the challenge question, and to submit the weekly work for assessment.

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 assignment 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

The content will be provided online through the class website. For additional help, the text for the course is

College Physics, Openstax College, 2022

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

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

Click “Download a PDF” or links on Blackboard. It is also available in a high quality paper copy through Open Stax. The online content in the book and has considerably more material than we will cover, but it is well-suited for self-study and we will recommend readings from some sections.

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 far more detail

than most textbooks provide. If you follow this suggestion, be selective in accepting answers from Internet resources. Wikipedia has proven to be very reliable, as are the sites supported by NASA and the selected links we provide for you. Post your questions to the Discussion Forum on our class page since often other students have seen the same issue we can work together to find answers and insights.

Information on useful software and other materials will be provided online. No matter what kind of computer you use, there will be tools available for you. Because the class is entirely online, you will need Internet access and would benefit from a laptop or desktop computer for working with the content and taking quizzes and exams.

Evaluation and grading

Required submissions to the question that challenges your understanding, the lab activity, quizzes and exams are administered online through Blackboard. We will evaluate your progress toward meeting the course and Cardinal Core objectives with a variety of question formats, and will include written responses to assess outcomes.

Each week after you study the content for the week, look for a “Challenge your understanding” topic on the class website. Give that some thought, discuss the topic with others as needed, and respond with an answer on Blackboard whenever you are ready. Our teaching assistant will assess your response and provide individual feedback as needed. The average score on these questions is 10% of your grade.

Weekly quizzes will help you to stay current in the course and understand and retain the new material. These quizzes are focused on the new material for the week. The average of quizzes for the course, counting the missed ones as zero, is 50% of your grade.

The weekly lab activity has a Blackboard assignment that is available through the week. This provides feedback to help you to understand the lab and learn from it, and with that guidance you may retake the lab quiz to improve your score. Blackboard records the last attempt during the week. The lab quizzes will be added and averaged to make 20% of your grade.

After 7 weeks, in time for a midterm progress assessment, there is a longer exam over the first half of the course. At the end of the term before the last day of classes another longer exam covers the second half of the course while also reviewing content from the semester. The average of the two longer tests is 20% of your grade.

You will receive weekly reminders by email about the new material and work that is due. Always expect a question to challenge to your understanding, a lab, and a quiz each week, with a longer test rather than a quiz at midterm and at the end of the course. These will appear on Blackboard under assignments when they are available. You may check your submitted work by looking at your Grades on Blackboard where weekly scores will be posted after Blackboard or our teaching assistant reviews your work. A common error on Blackboard is to forget to submit your work after you have answered the questions we posted. We cannot read work unless it is submitted, but we will try to provide reminders.

This is very important – you must fully participate in this course, that is, read and study the material, contribute to the discussion forum, submit an answer to the challenge

to your understanding, complete the lab, take every weekly quiz, and take both longer exams. Your final course letter grades are assigned from a weighted average of the grades on Blackboard and are A (90 to 100); B (80 to 89); C (70 to 79); and D (60 to 69). We use +/- grades within 2 points of these cuts. For example, 85 would be “B”, while 82 would be “B-” and 88 would be “B+”. If you follow your grades on Blackboard, please remember how the contributions are weighted. We will provide a midterm grade assessment for you after the first test, and we may reach out to ask if you need help or to offer advice if we see an issue developing. To do well, read and study the content, participate in the discussions at least occasionally, and do not miss assignments when they are scheduled. While we will try to advise you if we see an issue develop, it is your responsibility to study and engage in the course during the week and to be aware of the schedule.

Caveats

We reserve the right to make changes in the syllabus when necessary to meet learning objectives, when new Physics 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/sexual-misconduct-brochure>

What to do weekly

- Each Monday begins a new topic for that week.
- Study content on line, work through it at your own pace.
- Read the chapters or sections that are suggested in the textbook.
- Ask and answer questions on the discussion forum.
- Do the online lab activity for that week.
- Look at the *Challenge your understanding* and respond to it on Blackboard.
- Before end of day the following Monday, complete the weekly quiz for credit.

Longer tests

- The first longer test on Blackboard covers the first half of the course at midterm from Saturday morning of that week through the end of day on the following Monday.
- The second longer test on Blackboard covers primarily the second half of the course, though it may draw on material from the first half. It is also from Saturday morning of that week through the end of day on the following Monday.
- The course ends on the last day of classes for the semester when all work is due. There is no exam during finals week.

Grades

You must participate in the online course content every week, ask and answer questions on the discussion group, and respond to the assignments. If you do, then the final course grade is based on the quizzes (50%), the challenge questions (10%), the labs (20%), the two exams (20%).

Reminders

The class is organized to cover new material each week, so plan your study time with the online material and participate in the forums at least occasionally. Weekly quizzes open on Saturday morning and remain available through Monday at midnight. These are intended to help you review and understand the material and to keep up with the pace of the class. After you go through the online material, think about and respond to the challenge question, and read the textbook selections before taking the quizzes you should do well on them, and you will be prepared for the longer tests and retain the key ideas of the class.

Schedule and content

The primary content will be through links on Blackboard under **Content** that will take you to our resources. There are supplemental selections on the class website from the textbook and other resources as well. Participate in the online discussions to see what other students find helpful and interesting, and add your own too. Lab quizzes are available on Blackboard during the week. Content quizzes are available on Blackboard from Saturday morning. Both lab and quiz responses for the week are due by the end of the day the following Monday.

The schedule shows the topics by week you will find on the class website. Also consider the suggested optional reading from the online textbook.

19 August - 25 August Space and time

What is a vector?

The wheel and other works of genius

Chapter 1.1: An introduction

Chapter 1.2: Physical quantities and units

26 August - 1 September Gravity

What is gravity?

How to escape it

Chapter 2.7: Falling objects

Chapter 4.1: Force concept

Chapter 6.5: Newton's universal law of gravitation

2 September - 8 September Everyday forces: gravity and electromagnetism

Labor Day September 2

Electromagnetism is not gravity

Chapter 18: Introduction to electric charge and field Chapter 22: Introduction to magnetism

9 September - 15 September Electricity and magnetism

Electricity and magnetism go together

Chapter 20: Introduction to electric current

Chapter 20.4: Electrical power and energy

16 September - 22 September Light

Light and spectra know all and almost tell all

Light steps to the edge of the universe

Lenses help us to see the world

What is the nature of light?

Chapter 24: Introduction to electromagnetic waves

Chapter 25: Introduction to geometrical optics

23 September - 29 September Elements and isotopes of ordinary matter

Periodic Table: insight to everything

Fusion: Energy from hydrogen

Fission: Energy from uranium

Chapter 31: Radioactivity and nuclear physics

30 September - 6 October Atoms, gases, and plasmas

Midterm break

First longer exam is from Saturday through Monday

Atoms and molecules

Hot gases and the particulars of plasma physics

Chapter 30: Atomic physics

Chapter 11: Fluid statics

Chapter 13: Temperature and gas laws Mid-term exam is from Saturday through Monday

7 October - 13 October Condensed matter

Midterm exam from last week is due Monday

Condensed matter physics

Crystals

Synchrotrons and crystallography

Chapter 5.3: Elasticity

Chapter 16.2: Period and frequency in oscillations

Chapter 16.4: Pendulum

14 October - 20 October Space, time, and special relativity

What is so *special* about special relativity?

Light clocks and time dilation

Chapter 28: Special relativity

21 October - 27 October Quantum physics and spooky action at a distance

Quanta, particle physics, and making matter from nothing

Chapter 29: Quantum physics

28 October - 3 November Astrophysics: The Sun as a star and the Earth as a planet

Astrophysics and energy from the stars

Taking a planet's temperature

Sun's source of energy

Cosmic background radiation

Chapter 13.1: Temperature

Chapter 14.7: Heat radiation

Chapter 29.1: Quantization of energy

4 November - 10 November General relativity and gravity

Presidential election

Physics of black holes

Chapter 34.2: General relativity

11 November - 17 November Missing mass-energy

Dark energy, dark matter, and other mysteries

The discovery of dark matter

Chapter 34: Frontiers of physics

18 November - 24 November Physical laws and fundamental constants

Mindsteps from past to present

Map of physics

Constants that defy explanation

The story of the universe

Chapter 1.2: Fundamental units

25 November – 1 December Review for second test

Thanksgiving break

Second longer exam is from Saturday through Tuesday

2 December - 3 December Last day of classes December 3

All course work is due on Tuesday

The course does not have a comprehensive final