

Physics & Astronomy 111 – Elements of Physics – B

Fall Semester 2022 – 4 Credit Hours

Online Learning

Instructor

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Video Conference: by Zoom or Blackboard Collaborate on request

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.

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 "111-50" if the mail is about this class. Video conferences in my "virtual office" are available too, through the Zoom or Blackboard's Collaborate 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 on class website where questions that others may have could be asked.

The astronomy class has a teaching assistant who helps me with grading and who will also will help you if you need assistance. When the contact information for your assistant is available it will be added to the Blackboard site as well.

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 you should use the class website (see below) to work with new web-based interactive content, an online lab activity, and suggested readings from the textbook. During the week, Under Assignments on Blackboard, report on your work with the lab. Take a graded quiz on Blackboard over the week's content any time from Saturday morning through Monday midnight (US Eastern Time) at the end of each week. 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 quizzes and exams.

Blackboard

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

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

Use your University *User ID* and *Password* to log into Blackboard. Select the course PHYS-111-50-4222 (Elements of Physics - SL-Spring 2022) for the latest announcements, the weekly quizzes, and the two exams.

Start Here provides guidance the first time and will help if you are new to online classes.

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

Assignments will have your weekly quizzes and exams, available Saturday morning through Monday midnight.

Content has the link to our class web server. It is different from Blackboard and requires its own password (see below).

Tools is a link provided by the University to many different features of Blackboard and its commercial partners. If we need these (for example Collaborate Ultra) we will also link to them from Content. This tab is overflowing with options, most of which you do not need.

My Grades will be updated with recent work when it is evaluated. Your course grade is the average of 4 parts, of which the quizzes are 60% and each test is 15%, and the labs are 10%. You must participate in the class content and discussions as well, so be sure to stay active in the class each week.

Help will take you to Blackboard support. Please note that this does not provide help with our class website which we run ourselves. If you need help with it, send an email and we will work with you individually.

Class website

Content for this course is provided through our server at

<https://prancer.physics.louisville.edu/moodle>

which you may bookmark for direct access during the week, or click on the link in Blackboard for the course under Content.

This resource requires a login with a user ID and password. We create these accounts for you using your U of L ID (something like “ablast01”) which you use for access to university online resources. The list we use is based on Blackboard enrollment and it may lag your enrollment in the class by a day after Friday, January 7. You may send an email to remind us if the following does not work.

When you go to the class site the first time you will be asked to enter a user name and password. For the name use your U of L ID (in the form “ablast01”) For the password use the one we will provide on the Announcements page, and also on the Content link, of your Blackboard class. Once you do this the first time, the server will request that you enter a new password. You may then select your own. You may also edit your personal information on the server if you want to share it with others in the class. The next time you connect you will need to use the password you created. We advise not to use the same password you have on other university accounts for your own protection. Should you forget or need to change your password we will provide another one for you if you request one by email. This server does not store grades, but it provides records for us of your participation in the class, and we use it for the discussion forum for the course too.

If you are also in another online Physics & Astronomy class this semester you will only need to create a new password once. Once you log in, our site will offer the classes to you that we know you are taking.

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

Labs, quizzes and exams will evaluate your progress toward meeting the Cardinal Core objectives with a variety of question formats, and will include written responses to assess outcomes.

At the end of each week, quizzes will help you to stay current in the course and understand and retain the new material. These quizzes are focused on the material for the week, including the content of the labs, and they may also include questions from previous weeks that were often incorrectly answered. The average of quizzes for the course, counting the missed ones as zero, is 60% of your grade.

The weekly lab activity has a Blackboard assignment “quiz” about it 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 10% of your grade.

Consistent participation in this online class is a course requirement. We monitor your activity on the website that provides course content. You should log in to access the lab assignment and study the material there during the week before you take the quiz, much as you would attend weekly classes in a traditional course. The content is self-paced, and may lead you to explore on your own. While you study it, contribute to the discussion when you have a question or can offer an answer or comment for the benefit of your peers. The course is not passive, and we expect that you will actively engage in it. The labs require that you use the interactive content and guidance provided. The quizzes are based on the content we provide which is intended to focus on key ideas for you to understand and retain. The textbook and other online sources have supplementary detail to explore too.

You will receive weekly reminders by email about the labs, quizzes, and exams. Always expect a new quiz to be available from Saturday through Monday every week. These will appear on Blackboard under assignments during that time, the lab quiz will appear for the entire week. You may check your submitted work by looking at your Grades on Blackboard

where a weekly score will be posted after 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 posed. We cannot read work unless it is submitted.

This is very important – you must fully participate in this course, that is, read and study the material, contribute to the discussion forum, work through the lab assignment and report on it, take every weekly quiz, and take both longer exams. Given that, final course letter grades are approximately 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 quizzes, labs, and tests are weighted differently. 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 submitting labs and taking quizzes and tests when they are scheduled. The assignment of a letter grade based on averages of quizzes and exams is contingent on participation in the class. While we will try to advise you if we see an issue with non-participation develop, it is your responsibility to study and engage in the course during the week and to be aware of the quiz and exam 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>

Getting Started

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.
- Before end of day the following Monday, complete the weekly quiz for credit.
- Do the online lab activity for that week.
- At any time you are ready, for credit complete the weekly lab quiz on Blackboard. Once a lab quiz has been evaluated you may reconsider your work and retake it to improve your answers.

Longer Tests

- After 7 weeks and near midterm, the first longer test on Blackboard covers the first half of the course. It is given online from Saturday morning of that week through the end of day 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.

Grades

You must participate in the online course content every week, do the labs, and take all the quizzes and exams to receive a passing grade in this class. If you do, then the final course grade is based on the weighted sum of the components: 60% for the weekly quizzes, 10% for the labs, and 15% for each of the two exams.

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 through Monday midnight.

22 August - 28 August Space and time

- What is a vector?

- The wheel and other works of genius

29 August - 4 September Gravity

- What is gravity?

- How to escape it

5 September - 11 September Everyday forces: gravity and electromagnetism

- Electromagnetism is not gravity

12 September - 18 September Electricity and magnetism

- Electricity and magnetism go together

19 September - 25 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?

26 September - 2 October Elements and isotopes of ordinary matter

- Periodic Table: insight to everything

- Fusion: Energy from hydrogen

- Fission: Energy from uranium

3 October - 9 October Atoms, gases, and plasmas

- Atoms and molecules

- Hot gases and the particulars of plasma physics.

- First longer midterm exam is from Saturday through Monday

10 October - 16 October Condensed matter

- Condensed matter physics

- Crystals

- Synchrotrons and crystallography

17 October - 23 October Space, time, and special relativity

- What is so *special* about special relativity?

- Light clocks and time dilation

24 October - 30 October Quantum physics and spooky action at a distance

- Quanta, particle physics, and making matter from nothing

- 31 October - 6 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
- 7 November - 13 November** General relativity
General relativity and gravity
Physics of black holes
- 14 November - 20 November** Missing mass-energy
Dark energy, dark matter, and other mysteries
The discovery of dark matter
- 21 November - 27 November** Thanksgiving week
- 28 November - 4 December** Physical laws and fundamental constants
Map of physics
Constants that defy explanation
the story of the universe
Review and study for the second long exam, Saturday through Monday
- 5 December** Last day of classes
All course work is due today
The course does not have a comprehensive final