

Physics & Astronomy 111 – Elements of Physics – B

Spring Semester 2021 – 4 Credit Hours

Online Learning

Instructor

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Video Conference: by Zoom or Blackboard Collaboration on request

This class is entirely online. It uses content 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. 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.

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 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. This 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 about 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

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 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 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 apply your growing knowledge and skill to understand more fundamentally the nature of the physical universe and to use that to solve problems. Individual and group assistance through email, video conferencing, or telephone is available on request.

Each week the class website has new web-based content, suggested readings, an interactive review, and a lab activity. There is a graded quiz on Blackboard over the week's content that may be taken any time from Saturday morning through Monday midnight (US Eastern Time) at the end of each week. Lab work will be graded by a separate lab quiz that may be taken any time during the week. There will be two longer exams administered through Blackboard, one at midterm and the other during the final exam period. We will send email reminders weekly about the quizzes and exams.

Websites

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

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

Use your University *User ID* and *Password* to log into Blackboard for links to the content, discussions, quizzes, exams, and announcements. Once there, check the "Start Here", "Announcements", "Content", and "Assignments" tabs for your weekly guide.

Textbook

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

College Physics, Openstax College, 2016

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

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

Click "Download a PDF" or links on Blackboard. It is also available in a high quality paper copy through Amazon at low cost. The book is a supplement to the online content 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 Blackboard 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

Quizzes and exams will evaluate your progress toward meeting the Cardinal Core objectives.

There will be a quiz at the end of each week. Weekly quizzes will be added and averaged to make 25% of your grade.

A weekly lab activity also has a lab “quiz” based on it. Lab quizzes will be added and averaged to make 25% of your grade.

There will be 2 exams: the first near mid-term provides an early assessment of your progress; the second one, given in the final exam period, covers primarily the second half of the course but depends on earlier material too. Each exam counts 25%.

Each longer exam, the average of the weekly quizzes, and the average of the lab activities are equally weighted at 25% of your grade. An additional 5% will be added for consistent thoughtful contributions to the forum discussions on the class website.

This is very important – to complete the course and receive a passing grade, you must participate in the online course content, read and study the material, and take the self-assessment exercises. Given that, course final letter grades are approximately A (90 to 100); B (80 to 89); C (70 to 79); and D (60 to 69) assigned using the university’s recommended plus/minus system.

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.

<http://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.
- Take the self-assessments to see how you are doing.
- Before end of day the following Monday, complete the weekly quiz for credit.
- Do the online lab activity for that week if there is one.
- At any time you are ready, complete the weekly lab quiz, also on Blackboard, for credit. You may retake the lab quiz also at any time to improve your answers.

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 Tuesday.
- The second longer test on Blackboard covers the second half of the course from the first Saturday of finals week through the end of day on the following Tuesday. See the syllabus calendar for the dates.

Grades

You must participate in the online course content every week, 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 the average of four equally weighted components: the average of all the weekly content quizzes, the average of the lab quizzes, the midterm, and the second test with extra credit for contributions to the class discussion.

Schedule and Content

Follow the “What to do weekly” guide above, and check on Blackboard for the new material that includes interactive components, suggested reading, the discussion forum, and self-assessment activities that may help you judge your progress and problem-solving skills. The website will have suggested selections linked to the online version of the text each week, as well as other web-based content to supplement the primary content on our site. The textbook has far more than we have time to cover in class, yet it is at a level you can understand, and reading through the complete chapters would be helpful.

The required weekly quizzes for credit are available from Saturday through Monday, and you may submit the lab activity report any time during the week. You will receive weekly reminders to do the lab, take the quizzes and the tests but your participation in the online material on the class website is also a requirement of the class.

11 January - 17 January Measuring space and time

What is a vector?

The wheel and other works of genius.

18 January - 24 January Gravity and how to escape it

25 January - 31 January Gravity beyond Earth

Electromagnetism is different from gravity.

1 February - 7 February Electricity and magnetism go together

8 February - 14 February Light and spectra know all and almost tell all

Lenses help us to see the world.

What is the nature of light?

15 February - 21 February Periodic Table: insight to everything

Fusion: Energy from hydrogen.

Fission: Energy from uranium.

22 February - 28 February Atoms and molecules

Hot gases and the particulars of plasma physics.

First longer midterm exam is from Saturday through Tuesday.

1 March - 7 March Condensed matter physics

Crystals.

Synchrotrons and crystallography.

8 March - 14 March Special Relativity

What’s special about it?

Light clocks and time dilation.

15 March - 21 March Quanta, particle physics, and making matter from nothing

22 March - 28 March Astrophysics and energy from the stars

Taking a planet’s temperature.

Sun’s source of energy.

29 March - 4 April General Relativity

Physics of black holes.

5 April - 11 April Other mysteries

Dark energy, dark matter, and other contemporary physics topics.

12 April - 18 April Physical constants

Some defy explanation amidst Universal Physical Law.

19 April - 25 April The story of the universe

Review and study for the second long exam, Saturday through Tuesday

26 April - 29 April Continuation of final exam period

The second exam for this class is due on Tuesday, April 27

Any makeup work in the class must be finished by the end of day Thursday