

Physics & Astronomy 107 – Elementary Astronomy – S
Spring Semester 2019 – 3 Credit Hours
Online Learning

Instructor

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University email is preferable to a phone call, and will provide you with a written response you can save. Video conferences in my “virtual office” are available too, through the Zoom conferencing system if you have a microphone and webcam, or an Android cellphone or Iphone. Please send an email first to set up an appointment and for connection instructions.

Objectives

This course examines the entire universe, as observed today with the instruments of modern technology, and as explained with the ideas of physicists and astronomers. It meets the University’s Cardinal Core Requirements for a three hour Natural Science course. There is a separate optional Physics 108 laboratory, also offered online.

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

1. Help you understand (and cope with) astronomy encountered in everyday life: seasons, solar energy, and the GPS in your cell phone.
2. Provide a basis for understanding the latest developments about astronomy you will hear in the news.
3. Recognize that while physics does not fully explain the universe, it does predict the effects of intangible invisible things, even though nobody knows what they really are ... yet. (That is, not to fret when something seems incomprehensible, since science itself still does not explain everything, and has to rely on predictable behaviors of invisible things such as gravity and the properties of the fundamental particles which nobody completely understands.)
4. Present you with mysteries not yet solved, or with contradictory or untested theories, so that you may solve them in the future and win a Nobel Prize or have fun trying. (There is plenty of astronomy, not to mention physics, that we do not yet know.)
5. Teach physics and astronomy that you may apply to make life better for yourself and others now, and in the future.

6. Open your mind to new discovery by knowing that the universe 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 quizzes and three 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 and its evolution. This embodies many of the key discoveries of physical science from prehistoric measurements of seasons and eclipses through the most recent observations of gravitational waves. 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 astronomy is based on observation and measurement, the analysis of the observations depends on physics. The emphasis in this course is not as much on fact as it 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. The requisite simple but essential physics is incorporated into the course content. The fundamental ideas of physics and other sciences unify our understanding of the current state of the universe, and allow us to predict or model its future. Examples include the motions of the Earth and other planets in our solar system,

the formation of stars and planets, the evolution of the universe from its beginning to the appearance of matter as we know it today, the future of our Sun, and indeed of the universe itself. 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 space exploration and the costs of large scale scientific instrumentation and research. Other topics of pressing concern are the energy balance of the Earth, including the effects of planetary atmospheres on surface temperatures, the habitable zone around the Sun and other stars, our search for planets and life elsewhere in our Galaxy, and the eventual demise of the Sun and our planet. Special attention is drawn to sunlight as a source of useful power for personal as well as larger grid-scale applications. This content is included on the weekly quizzes and exams, and because it is a culminating application that draws on the entire course content as a foundation, it is emphasized in the final exam.

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 exams. The topics for these questions are developed 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 use your growing knowledge and skill to understand our universe. Individual and group assistance through email, our Zoom video conferencing system, or telephone is available on request.

Each week the class website has new web-based content, suggested readings, and an interactive review. 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. There will be three longer tests administered through Blackboard,

one at midterm, one at the end of the course, and one during the final exam period. The midterm and second tests will also be open from Saturday to Monday midnight. The final exam, however, is open from the first day of finals, usually on Wednesday, through the following Saturday. We will send email reminders weekly about the quizzes and exams. All course work must be completed by last date posted for the final exam.

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 announcements, the quizzes, tests, and the final exam.

For this Elementary Astronomy class, all of the instructional content will be managed on our program website at

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

This site is available only to registered students, and it requires a personal password that is different from your university computer password. Instructions on how to use this system will be posted on Blackboard and sent to registered students by email on or before the first day of classes. Please contact Professor Kielkopf if you have not received this by the second day of classes, or if you have difficulty logging into the website. The University's Help Desk can only respond to questions about Blackboard.

Textbook

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

Astronomy, Openstax, 2016, by Andrew Fraknoi, David Morrison, Sydney C. Wolff
<https://openstax.org/details/astronomy>

It is online, and also a downloadable PDF through the above link ("Download a PDF"). A print version is also available, through the Openstax site which links to Amazon. We have noted recommended chapters in the text for reading. Most other introductory elementary astronomy books are fine as a supplement to the online material too if you already have one.

In many cases, simply by using Google and looking for an appropriate entry in the Wikipedia you can find an answer to basic astronomy and 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, ESA, and ESO.

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. 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 software, please use our website and post your question to the 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

Quizzes and exams will evaluate your progress toward meeting the course and 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. The quizzes and exams will use a variety of question formats, and will include written responses to assess outcomes for course objectives.

There will be 3 exams: the first is near mid-term; the second at the end covering the second half of the course, and a third one during the final exam period covers the entire course. Each exam counts 25%.

An additional 5% will be added for students who make consistent thoughtful contributions to the forum discussions on the class website.

To complete the course and receive a grade, you must participate in the online course content, self-assessment, and discussion forums. Given that, letter grades are based on the graded quizzes and exams, and scoring on quizzes and exams is based on a simple percentage of correct answers and assessment of written responses that are included in this work.

Letter grades are approximately A (90 to 100); B (80 to 89); C (70 to 79); and D (60 to 69). Plus and minus grades may be used when a numerical score is within 2 points of a letter grade division.

Caveats

We reserve the right to make changes in the syllabus when necessary to meet learning objectives, when new astronomical 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 Resource Guide.

Getting Started

- From the notice on Blackboard or our emails to you, locate your username and your password to our class website
- Connect to <http://prancer.physics.louisville.edu/moodle>
- Select your class and log in with your username and password (case sensitive)
- First time login you will be asked to change your password
- Update your profile if you want others to know more about you (optional)
- If you have a problem with this, send an email to kielkopf@louisville.edu

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 on the class website to see how you are doing.
- Before end of day the following Monday, complete the weekly quiz on Blackboard 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 the second half of the course from Saturday morning of that week through the end of day on the following Monday.
- It is followed by a comprehensive final exam from Wednesday of finals week through the end of day Saturday that week. See the syllabus calendar for the dates.

Grades

The final course grade is based on the average of four equally weighted components: the average of all the quizzes, the midterm, the second test, and the final.

Schedule and Content

The primary content is online on the class website. These chapters are selected supplemental reading from *Astronomy* by Fraknoi, Morrison, and Wolff. These suggestions may change. Please check the class website and participate in the online discussions to see what other students find helpful and interesting. Weekly quizzes for credit are on Blackboard from Saturday morning through Monday midnight.

January 7 - 13 Constellations

Chapter 2.1: The Sky Above
Star charts and other links online.

January 14 - 20 Sun keeps us warm

Chapter 4.1: Earth and sky
Chapter 4.2: The seasons
Chapter 8.4: Life, chemical evolution, and climate change
Chapter 15.1: Sources of sunshine

January 21 - 27 Telescopes & Solar system

Chapter 6.2: Telescopes today
Chapter 7.1: Overview of our planetary system

January 28 - February 3 The Moon

Chapter 9.1: General properties of the Moon
Chapter 4.6: Ocean tides and the Moon
Chapter 4.7: Eclipses

February 4 - 10 Mars & Saturn

Chapter 10.4: Geology of Mars
Chapter 10.5: Water and life on Mars
Chapter 11.2: Giant planets

February 11 - 17 Comets, asteroids, meteors, and meteorites.

Chapter 13.3: Comets
Chapter 13.1: Asteroids
Chapter 14.1: Meteors
Chapter 14.2: Meteorites

February 18 - 24 Periodic table of elements and the universe.

Chapter 5.4: Structure of the atom
Chapter 16.2: Mass and energy
Appendix K: The elements
Chapter 18.1: A stellar census
Chapter 18.4: Hertzsprung-Russell diagram
Chapter 20.5: Life cycle of cosmic material
Review for the first test.

Saturday, February 23, through Monday, February 25 First test.

February 25 - March 3 Subatomic particles, birth and death of stars, black holes.

Chapter 21.1: Star formation

Chapter 22.1: Evolution from the main sequence to red giants

Chapter 23.1: Death of low mass stars

Chapter 23.2: Evolution of massive stars: an explosive finish

Chapter 21.5: Planets everywhere

March 4 - 10 Things beyond our understanding.

Chapter 25.3: Mass of the galaxy

Chapter 28.4: Challenge of dark matter

Chapter 28.5: Structure of the universe

March 11 - 17 Spring Break week.

March 18 - 24 How to measure distances across the universe.

Chapter 19.2: Surveying the stars

Chapter 19.4: H-R diagram and cosmic distances

Chapter 26.4: Extragalactic distance scale

March 25 - 31 Special and general relativity.

Chapter 24.1: Introducing General Relativity

Chapter 24.2: Spacetime and gravity

Chapter 24.5: Black holes

April 1 - 7 The expanding universe and the beginning of time.

Chapter 26.5: Expanding universe

Chapter 29.1: The age of the universe

Chapter 29.2: A model of the universe

Chapter 29.3: The beginning of the universe

April 8 - 14 Galaxies near and far.

Chapter 26.1: Discovery of galaxies

Chapter 26.2: Types of galaxies

Chapter 29.4: The cosmic microwave background

April 15 - 21 The story of the universe.

Chapter 29.3: The beginning of the universe

Chapter 29.5: What is the universe really made of?

Chapter 29.6: The inflationary universe

Review and study for second test.

Saturday, April 20, through Monday, April 22 Second test.

April 22 - 28 Final exam week.

Review and study for the final.

Wednesday, April 24, through Saturday, April 27 Final exam.