# Astronomy Lab

## Course Description

This course introduces the student to the tools and techniques used by astronomers to study moons, stars, and clusters. We will use CLEA’s virtual observatory (VIREO) to locate and study different objects in space, using a variety of telescopes and tools such as spectrometers and photometers. We will also use internet resources such as sky charts and the SIMBAD astronomical database to research stars.

## Required Text

The text that accompanies this course is *The Essential Cosmic Perspective*. (Bennet, 2018)

## Prerequisites

There are no prerequisites for this course.

## Learning Outcomes

* Use sky charts to locate and study the motion of stars relative to Polaris.
* Explain how the celestial coordinate system is used to determine the location of an object.
* Look at the night sky in conjunction with a sky map to locate bright stars that make up major constellations.
* Operate CLEA's VIREO to simulate the use of different telescopes to locate objects in space and use the built-in photometer to determine stellar magnitude.
* Use Kepler's Third Law to determine the mass of a parent body.
* Determine the orbital characteristics of the four Galilean moons of Jupiter by taking measurements of their perpendicular distances from Jupiter and plotting a sine curve to calculate the orbital radius and period for each moon.
* Explain the correlation between a star's spectra, its temperature and magnitude, and how this can be used to determine its distance.
* Understand the H-R diagram and how the locations of the stars on the diagram help in categorizing the stages of stellar evolution, and how comparing a star cluster's H-R diagram with theoretical isochrones can be used to determine the age of stars in a cluster.
* Explain the life-cycle of a typical star and how a supernova occurs in a higher-mass star.
* Use a simulated space-based X-ray observatory to observe a supernova remnant and analyze the X-ray spectra to determine the composition of the gas and some of its physical characteristics.
* Discuss the effects of supernovae on the composition of stars and the role a supernova may have played in the formation of our own Sun.

## Course Topics

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| --- | --- |
| Category/Topics | Learning Content |
| Studying the Night Sky | Explain the concept of the celestial sphere and how the celestial coordinate system works. Use an online sky chart to find planets and major constellations visible from your location. |
| Studying Stars through Photometry | Explain how photometry is used to study stars. Distinguish between apparent and absolute magnitude. Use the VIREO software to study Polaris and determine its apparent and absolute magnitude, B-V index, and spectral type. Explain how stars are plotted in a Hertzsprung – Russell diagram. |
| The Revolution of the Moons of Jupiter | Describe Jupiter, the Giant Red Spot, and the four Galilean moons. Explain Kepler’s Third Law. Use VIREO to observe the Galilean moons. Record data about their orbits and plot a sine curve to the data to determine the orbital period and radius for each moon. Calculate the mass of Jupiter based on the orbits of its moons. |
| H-R Diagrams of Star Clusters | Explain how a star forms and becomes a main sequence star. Differentiate between open clusters and globular clusters. Define the zero-age main sequence and explain how it can be used to estimate the age of a star cluster. Use VIREO to plot an H-R diagram of different star clusters, and then use the zero-age main sequence and isochrones to determine the distance, age, and other properties of each cluster. |
| Dying Stars and the Birth of the Elements | Summarize the life cycle of a star and explain how a supernova occurs. Explain how and why X-Ray telescopes are used to study supernovae. Use VIREO to collect spectra for different knots of gas in a supernova remnant. Analyze the spectra to determine temperature, absorption, and composition of the knots of gas. Explain how supernovae contribute to the abundance of heavy elements in the universe. |

## Lab Exercises

The lab exercises are hands-on activities using tools such as a skychart and virtual observatory software. You can repeat the questions as preferred but will need to achieve a score of 80% or higher on the lab exercises associated with a lesson before that lesson is marked as complete. You will then receive the appropriate proportion of the total number of points available for the lab exercises based on the overall average score for all lab exercise sections in the course.

**Important! Lab exercises are manually graded by a human being and can take up to five business days to be graded and inputted into the system. You will not be able to advance to the next lesson until the current lesson has been marked as complete with a minimum score of 80%.**

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## Course Time Limit

This course is self-paced, which means you can complete the course requirements at a pace that is comfortable for you. However, there is an overall time limit of 180 days to complete each course, starting from the date on which you registered. This time limit is indicated on your Courses screen as “Course Period.”

Once the time limit has passed, you will no longer be able to attempt any further activities or assessments. Assuming you have not yet attempted the Final Exam, you can immediately unregister and reregister for the course to start over. Otherwise, you will be required to wait to reregister per our Course Retake Policy.

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## Course Retake Policy

There is a one-week waiting period before this course can be re-taken, starting from the date of the last Final Exam attempt.

To retake the course, first unregister from the course on your Courses screen. If it has been over a week since your last attempt, you will then be able to register for this course again.

Your highest final score for the course will be used for the transcript.

## Exams

The only exam for this course is a Final Exam consisting of 25 questions. The questions are a mixture of short answer and multiple-choice and will cover material from the lectures as well as the lab exercises.

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| --- | --- | --- | --- |
| **Exam** | **Coverage** | **Number of Questions** | **Time Limit, Minutes** |
| **Final** | Lessons 1-5 | 25 | 90 |

## Grading

To determine your level of mastery for this course, you will earn points by successfully completing the learning and evaluation activities below in sequence.

|  |  |
| --- | --- |
| Source | Points Available |
| Lab Exercises | 500 |
| Final Exam | 500 |

Upon completion of the course and the grading source activities, InstantCert will provide you with a percentage score. The minimum passing score is 700 points, or an overall course grade of 70%.

**Important! Only a passing score on a course marked 100% complete (including the proctored final exam) is eligible for college credit.**

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## Proctoring of the Final Exam

A proctor is a person who monitors the work of another person who is taking an examination. Online proctoring services allow you to take the working remotely and in the same way as if you were sitting in an exam room. Proctoring ensures that the test you take complies with current college level examination policies.

Proctoring is used only for the final exam. It is offered through the online proctoring service RPNow at the Software Secure web site. You will pay a separate fee to RPNow for each final exam attempt.

RPNow requires that students download and install proprietary software. They will need to use a PC or a Mac with a webcam. Students can review the full system requirements for RPNow at:

<http://clientportal.softwaresecure.com/support/index.php?/Knowledgebase/Article/View/252/0/system-requirements-remote-proctor-now>

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## Exam Retake Policy

The final exam can be retaken ONCE. There is a 3-day waiting period before you will be allowed to retake the exam. If you retake the exam, the higher result of your two attempts will be used to calculate your final score.

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## Academic Integrity

You are required to comply with the InstantCert full Student Code of Conduct, which specifically prohibits cheating or any other academically dishonest behavior. Violation of any part of the Student Code of Conduct can result in a grade reduction or even suspension from the course.

## Third-Party Software

For this course, you will need to download the virtual observatory software (VIREO) from Project CLEA. The Project CLEA website is hosted by Gettysburg College:

<http://www3.gettysburg.edu/~marschal/clea/CLEAhome.html>

The lecture notes for lessons 2 through 5 provide additional instructions for downloading VIREO and its relevant modules.

## Software Requirements

The operating system, browser, internet access and speed are provided below for use with courses from the InstantCert web site.

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| **Operating Systems** | * Windows XP and above * Mac OS X |
| **Browsers** | * The latest version of Chrome, Firefox of Safari * IE9 or higher |
| **Internet and Speed** | Broadband Internet; 1Mbps or higher |

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## Accessibility and Disability Accommodations

InstantCert strives to make online education accessible to people everywhere in the following ways:

* All course content is available online, accessible from anywhere through an Internet connection.
* All video lessons include a transcript for use by those who are hearing impaired and/or by students that wish to have written copies of the lessons.
* All video lessons have close captioning.
* Lesson pages can be navigated by screen readers.
* Videos may be replayed an unlimited amount of times. Video speed can be increased or slowed.
* Lesson transcripts and quizzes can be printed for offline use.
* The proctoring software RPNow works with screen readers.