Course Acronym:	ASTR
Course Number:	12
Descriptive Title:	Astronomy Laboratory
Division:	Natural Sciences
Department:	Astronomy
Course Disciplines:	Astronomy, Physics
Catalog Description:	The astronomy laboratory provides students with an introduction to the observation of the sky with telescopes, binoculars, and the unaided eye. The student will become familiar with the principles of set up and operation of telescopes and use them to view the Moon, the Sun, planets, stars, star clusters, and nebulae. The student will use the principles of astronomy to interpret their observations. Students will also learn to identify the bright stars and major constellations visible in California. Note: This course is offered only at night.
Prerequisite:	Astronomy 20 or Astronomy 20H or Astronomy 25 or Astronomy 25H with a minimum grade of C in prerequisite or Concurrent Enrollment
Co-requisite:	
Recommended Preparation:	
Enrollment Limitation:	
Hours Lecture (per week):	0
Hours Laboratory (per week):	3
Outside Study Hours:	0
Total Course Hours:	54
Course Units:	1
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes

Effective Date:	Prior to July 1992
Transfer UC:	Yes
Effective Date:	fall 1995
General Education: ECC	Area 1 - Natural Sciences
Term:	
Other:	
CSU GE:	Area B1 - Physical Universe and its Life Forms: Physical Science, Area B3 - Physical Universe and its Life Forms: Laboratory Activity
Term:	
Other:	
IGETC:	Area 5C - course that incorporate a laboratory
Term:	
Other:	
Student Learning Outcomes:	**SLO #1 Scientific Method** Students will be able to apply the Scientific Method to the solution of astronomical problems. **SLO #2 Locating Celestial Objects** Using a Cassegrain reflecting telescope, students will be able to align the telescope and point it at several objects, including the Moon, planets visible to the naked eye, planets invisible to the naked eye, bright stars, faint stars, and diffuse objects (clusters, nebulae, and galaxies).
Course Objectives:	1. Use the Scientific Method to investigate an astronomical observation. 2. Make observations and measurements and collect the date. 3. Interpret the results and draw appropriate conclusions from the data. 4. Estimate errors in the data and in numerical results computed from the data. 5. Write a technical lab report. 6. Recognize and identify the major constellations, planets and bright stars visible from California. 7. Apply knowledge of the sky to identify the directions north, south, east, and west anywhere in the northern hemisphere. 8. Set up and orient a small to medium-sized telescope. 9. Compare the designs of refracting and reflecting telescopes and their properties such as field of view, magnification, light gathering power, and resolution. 10. Use a celestial co-ordinate system to locate a variety of objects in the sky with a small telescope. 11. Use the stellar magnitude system to compare star brightness. 12. Identify and measure or estimate physical sizes of major surface or atmospheric features of celestial objects, for example, the Sun, the Moon, open and globular star clusters, galaxies and nebulae. 13. Interpret the physical properties of stars using the properties of light. 14. Observe and interpret phase appearances of planets.
Major Topics:	**I. Astronomical Concepts (16 hours, lab)**

	A. Scientific Methods, Measurements, and Interpretation B. Telescopes 1. Optical Design 2. How to Use C. Digital Cameras, Data Acquisition, and Data Reduction D. Celestial Coordinate System 1. Identification of Brightest Stars 2. Constellation Identification 3. Use of a Star Atlas 4. Polar Alignment and Use of Telescopes **II. Visual Observation of Celestial Objects (12 hours, lab)** A. Moon B. Planets C. Star Clusters D. Binary Stars **III. Imaging and Analysis of Common Astronomical Objects (16 hours, lab)** A. Nebulae and Galaxies B. Star Clusters C. Moon D. Planets **IV Study of Real and Apparent Motions (10 hours, lab)** A. Sun 1. Rotation B. Moon/phases 1. Weekly C. Planets and their satellites 1. Jupiter, Saturn, Mars 2. Orbital Motion of Satellites 3. Rotation (if possible) D. Constellations 1. Diurnal 2. Seasonal
Total Lecture Hours:	0
Total Laboratory Hours:	54
Total Hours:	54
Primary Method of Evaluation:	2) Problem solving demonstrations (computational or non-computational)
Typical Assignment Using Primary Method of Evaluation:	GIANT PLANETS

	PURPOSE: In this lab you will observe and image giant planets and measure several of their properties. PROCEDURE: 1. Align the telescope for observational use (no polar alignment necessary). 2. Sketch the target planet and its satellites. Indicate colors, observed satellites, observation time, eyepiece focal length, and which satellite is the brightest. 3. Calculate magnification and include it on your data sheet. 4. Swap the eyepiece for an astrophotography camera, and collect photographic data of the target planet. 5. Reduce data and generate and image from your data set. 6. Repeat after an hour to observe differences in planetary rotation and satellite placement. 7. Using astronomical resources, identify the satellites in your sketch. Label these satellites. 8. Answer various questions regarding the target planet using your sketches and images 9. Using a computer program measure the major and minor axes of your planet and calculate the oblateness. 10. Estimate the rotation rate of the planet using your two images.
Critical Thinking Assignment 1:	BINARY STARS PURPOSE: In this lab exercise, you will learn to distinguish “red” giant from “red” main sequence stars in binary pairs. PROCEDURE: 1. Using your star atlas, find 4 to 8 double stars visible in an 11in f/10 telescope from Los Angeles. Separations must be higher than 6 arcseconds and magnitudes must be brighter than 8^{th} magnitude. 2. Observe your selected stars. Indicate which of the pair is brighter and the color of each of the two stars. 3. Using your collected data, find the position angle of each binary pair. 4. Using your collected data determine whether the cooler star is main sequence or giant. Recall that for a cooler star to be as bright as or brighter than a hotter star, it must be larger. 5. Answer various questions regarding the formation and evolution of binary stars based on data, in class discussion, and astronomy textbooks.
Critical Thinking Assignment 2:	OBSERVATION OF STAR CLUSTERS PURPOSE: In this lab exercise, you will learn how to compare ages of various cluster types. Procedure 1. Select clusters to observe. Use a star chart to make sure they will be above the horizon this evening. 2. Set up a telescope and polar align. 3. Find your cluster and select the magnification that enables you to see it best.

	4. Sketch what you observe in the telescope in your lab notebook. 5. Take observation notes on brightness and color (if visible). 6. Connect an astrophotography camera and take photographic data of both cluster types. 7. Reduce and image data using standard astrophotography tools. 8. Count and compare the number of red and blue giant stars in each cluster type. 9. Use collected data to generate an HR Diagram of two clusters. 10. Compare the ages of the two selected clusters based on where they turn off of the main sequence.
Other Evaluation Methods:	Laboratory Reports, Other Exams, Quizzes
Instructional Methods:	Demonstration, Discussion, Lab
If other:	
Work Outside of Class:	Course is lab only - minimum required hours satisfied by scheduled lab time
If Other:	
Up-To-Date Representative Texts:	Wil Tirion, The Cambridge Star Atlas, 4th edition, Cambridge University Press, 2011 (Discipline Standard) Lab Manual with information, instructions, and questions prepared and distributed by ECC Astronomy Dept. Faculty (unpublished work. Last updated 2023)
Alternative Texts:	Wil Tirion. Bright Star Atlas, Willman-Bell, 2006. (Discipline Standard) David Vakil. Astronomy Laboratory Manual. ECC Bookstore, 2005. (Discipline Standard) Leon Palmer. Trained Sky. 1st ed. Rigel, 2011. (Discipline Standard)
Required Supplementary Readings:	
Other Required Materials:	
Requisite:	Prerequisite
Category:	standard
Requisite course(s): List both prerequisites and corequisites in this box.	Astronomy-20 or Astronomy-20H or Astronomy-25 or Astronomy-25H
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**List the basic precepts of the Scientific Method.** ASTR 20 - Judge whether a particular study is science or a "pseudo-science" using the scientific method.

	ASTR 25 - Judge whether a particular study is a science or a "pseudo-science" using the scientific method. ASTR 25H - Compare and contrast the scientific method to pseudo science. **Distinguish between planets and stars.** ASTR 20 - Compare the characteristics of the major planets and major moons of the Solar System. ASTR 20H - Compare the characteristics of the major planets and major moons of the solar system. ASTR 25 - Explain how electromagnetic radiation and astronomical instruments are used to reveal the properties of stars and galaxies. ASTR 25H - Explain how electromagnetic radiation and astronomical instruments are used to reveal the properties of stars and galaxies **Describe the effect of the apparent motion of the Sun, (the Moon and other planets) along the ecliptic as a consequence of the Earth's orbital motion**. ASTR 20 - Predict the phase of the Moon and/or type of eclipse that would be seen in the sky, given the positions of the Earth, the Sun, the Moon, and the observer. ASTR 20H - Predict the phase of the Moon and/or type of eclipse that would be seen in the sky, given the positions of the Earth, the Sun, the Moon, and the observer. ASTR 25 - Discuss the solar cycle and how it affects the Sun and the Earth. ASTR 25H - Describe the solar cycle and how it affects the Sun and the Earth.
Requisite Skill:	
Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable	
Requisite course:	
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	
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Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	A. Cockrum, J. Garrison, E. Baldwin
Date:	11/01/1962
Original Board Approval Date:	FALL 1962
Last Reviewed and/or Revised by:	Shimonee Kadakia
Date:	09/24/2023
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