ASTR 0014 - ASTROPHOTOGRAPHY AND IMAGING

Catalog Description

Prerequisite: Completion with grade of "C" or better or concurrent enrollment in ASTR 2, 5, or 10
Advisory: Completion of ENGL N with grade of "C" or better
Hours: 54 laboratory
Description: Basic principles and practices of astrophotography and image processing. Astronomical observations and data collection associated with the use of telescopes, binoculars, computers, cameras, and other related equipment. Development of observational techniques and data analysis procedures for the study of the outdoor sky with related indoor experiments and studies. Particular emphasis placed on quantitative and qualitative analysis of a variety of astronomical data collected with cameras. NOTE: About 5 nights of activities will be required. (CSU, UC)

Course Student Learning Outcomes

- CSLO #1: Explain celestial navigation, evaluating the significance of important astronomical phenomena.
- CSLO #2: Operate a variety of optical systems, demonstrating proficiency in their use.
- CSLO #3: Use various imaging systems to produce high quality image data products, demonstrating overall mastery of image reduction skills.

Effective Term

Fall 2021

Course Type

Credit - Degree-applicable

Contact Hours

54

Outside of Class Hours

0

Total Student Learning Hours

54

Course Objectives

Through assigned tasks, peer-lead hands-on activities, computer simulated exercises, classroom discussions, and quizzes/exams, students will:
1. Perform computations making proper use of significant figures, scientific notation, calculators, and digital computers
2. Maintain a log of all laboratory and field activities
3. Describe the general optical construction of reflector and refractor telescopes along with their inherent advantages and disadvantages
4. Compute the following optical characteristics of a telescope: magnification power (M), practical magnification (PM), light gathering power (LGP), resolving power (RP), field-of-view (FOV), and f-ratio (FR)
5. Compare and contrast the computed optical characteristics M, LGP, FOV, and FR of a simple telescope with those measured in the lab through the use of an optical bench
6. Determine the optimal telescope to use for a given observational arrangement based on purpose, cost, and portability
7. Describe the observational techniques of astrometry, photometry, and spectroscopy
8. State the functions and processes of an astronomical observatory
9. Explain how to use a computer to link to remote telescopes to collect astronomical data
10. Use image processing software
11. Use rulers, protractors, reticule magnifiers, and similar devices to measure features on astronomical photographs
12. Create a digital image using a CCD camera
13. Create a light-curve using a CCD camera and variable light source in the lab
14. Use a spectrometer to measure and interpret emission lines from fluorescing gas tubes
15. Plan an observing session through the use of constellation charts, celestial almanacs, and astronomical computer software
16. Properly set up a small computerized telescope to visually observe a celestial object during day or evening hours
17. Properly set up a small computerized telescope for the purpose of observing a celestial object with either a camera (DSLR or CCD) or spectrometer
18. Describe, locate, and image the Moon (or Sun), a planet, a multiple star system, a star cluster, a nebula, and a galaxy
19. Complete a semester project in imagery, astrometry, photometry, or spectroscopy which includes a series of images generated using either a 35mm, digital or a CCD digital camera and corresponding image and data analysis

General Education Information

- Approved College Associate Degree GE Applicability
  - AA/AS - Physical Sciences
  - AS - Physical Science Lab
- CSU GE Applicability (Recommended-requires CSU approval)
  - CSUGE - B3 Lab Activity
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)
  - IGETC - 5C Laboratory Science

Articulation Information

- CSU Transferable
- UC Transferable

Methods of Evaluation

- Objective Examinations
  - Example: Standard quizzes, mid-term, and final exams consisting of a variety of tasks and question formats, evaluating all levels of performance according to Bloom's taxonomy (knowledge, understanding, application, analysis, synthesis, and evaluation) Example exam question: Which settings on the DSLR camera will give you the best astrophotography pictures.
- Problem Solving Examinations

    - Example: On the Midterm and Final, students will show their ability to calculate magnification, Light Gathering Power and Field of View of a telescope. Example: what is the magnification of a telescope with Focal Length = 2000 mm and an eyepiece labeled 40 mm?
- Projects
    - Example: Students will present a portfolio of their work at the end the semester, consisting of photos they and their lab partners have taken throughout the semester. Example: Prime Focus image of Orion Nebula - was the image presented neatly and information about image was displayed accurately and cleanly.
- Reports
    - Example: Laboratory exercises to evaluate student comprehension of weekly assignments and assigned reading. Example question given at the end of a laboratory assignment: From the optical bench measurements made on 5 lenses, was there a correlation between f-ratio and image brightness?
- Skill Demonstrations
    - Example: Students and their lab partners will show their ability to set up an tear down telescopes and set up and tear down DSLR cameras with lenses and tripods. (Example: the first field trip consists of getting to know the telescope. Student learn how to set up and alight the telescope as well as how to properly put away the telescope).

Repeatable

No

Methods of Instruction

- Laboratory
- Distance Learning

Lab:

1. Students are taught what characteristics of a telescope and eyepiece determine magnification, light gathering power, field of view, and resolving power. Using this basic information, students must then answer questions relating different parameters to each other, and what external factors would limit the telescope performance – for example earth based telescopes vs. space-based telescopes. (Objectives 4,5,6)
2. Reading from the required course text and/or handouts is assigned on a regular basis. Weekly lab assignments require students to read procedures and expected analysis. (Objectives 1,2) Field Trip Activity:
3. Students are expected to be on 5 field trips to learn how to run a telescope and use a DSLR Camera. Term project requires a written lab reports and a presentation of a portfolio of images taken throughout semester. (Objective 19)

Typical Out of Class Assignments Reading Assignments

1. Reading from assigned text on a weekly basis Example reading: Read chapter on coupling camera to telescopes. Students are informed of current lab topic. 2. Reading from weekly laboratory exercise sheets (included in required student laboratory manual) on a regular basis. Example reading: Read handout on setting up the telescope. Students are prepared for that week's lab.

Writing, Problem Solving or Performance

1. Weekly laboratory reports Example report: Complete and submit the lab "Celestial Tools" found in the student laboratory manual. 2. Written project report Example project: From observations taken over several observing sessions with digital and CCD cameras, provide a detailed portfolio of images taken, including documentation. 3. Quizzes, midterm, and final exam to demonstrate acquisition of critical thinking skills and astronomical knowledge. Example exam question: For the purposes of astrophotography, describe the benefits and problems associated with a telescope with a large objective (primary) mirror.

Other (Term projects, research papers, portfolios, etc.)

One assignment is given for each week of class. Each of these assignments will be of a nature that is reflective of the course outcomes. In particular, students will acquire this experience through computer simulations, access to a telescope, and/or a public telescope observation site (either at a Sierra College Astronomy Department site or one owned by an individual or a group with partnership ties to Sierra College). Example assignment: Acquire and assess data captured via the Internet from a remote telescope site.

Required Materials

- Astrophotography
    - Author: Thierry Legault
    - Publisher: Rocckynook
    - Publication Date: 2014
    - Text Edition: 1st
    - Classic Textbook?: No
    - OER Link:
    - OER:

Other materials and-or supplies required of students that contribute to the cost of the course.

1. Laboratory exercise packet prepared by instructors and updated every semester and distributed through local bookstores. 2. Laboratory handbook prepared by instructors and updated every semester and distributed through local bookstores. 3. Constellation Charts SC-001 (Equatorial Region) and SC-002 (North Circumpolar Region). 4. "Skygazer's Almanac" for the most current year.