| | |
|---|---|
| **Course Acronym:** | ASTR |
| **Course Number:** | 13 |
| **Descriptive Title:** | Astronomical Optics |
| **Division:** | Natural Sciences |
| **Department:** | Astronomy |
| **Course Disciplines:** | Astronomy, Physics |
| **Catalog Description:** | In this course, the student will be introduced to principles of astronomical optics. The student will apply those principles to the design, fabrication, and use of a telescope, which will be tested under the night sky. Primary mirrors will be ground, smoothed, polished, and figured by hand. Extensive testing will be done in the optical shop. Optics and optical testing theories will be presented. Students will design and build a custom optical tube assembly and telescope mount.<br><br>Note: Students pay a minimum cost of $375 for a completed telescope. |
| **Prerequisite:** | |
| **Co-requisite:** | |
| **Recommended Preparation:** | Astronomy 20 or Astronomy 20H with a minimum grade of C<br><br>Astronomy 25 or Astronomy 25H with a minimum grade of C<br><br>Proficient in intermediate algebra skills |
| **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, non degree applicable |
| **Transfer CSU:** | Yes |
| **Effective Date:** | 4/26/1993 |
| **Transfer UC:** | pending |
| **Effective Date:** | |
| **General Education: ECC** | |
| **Term:** | |

| | |
|---|---|
| **Other:** | |
| **CSU GE:** | |
| **Term:** | |
| **Other:** | |
| **IGETC:** | |
| **Term:** | |
| **Other:** | |
| **Student Learning Outcomes:** | **SLO #1 Optical Surfaces**<br><br>The student will understand and apply the principles of testing optical surfaces. |
| **Course Objectives:** | 1. Rough grind, smooth, and polish a telescope mirror.<br>2. Measure the focal length of a mirror.<br>3. Determine the quality of an optical surface.<br>4. Figure a telescope mirror.<br>5. Measure the zonal foci using the Foucault test.<br>6. Calculate the zonal errors and infer a mirror's shape.<br>7. Design and construct the optical tube assembly for a telescope.<br>8. Select the appropriate secondary mirror for a telescope.<br>9. Design and construct a baffle system for an optical tube assembly.<br>10. Collimate an optical tube assembly.<br>11. Star-test a telescope and estimate the wave front error of an optical tube assembly. |
| **Major Topics:** | **I. Overview of Telescopes and Their Purpose (1 hour, lab)**<br><br>A. Magnification<br>B. Magnitude System<br>C. Field-of-View<br>D. Mirror-Making Steps<br><br>**II. Optics Terminology (3 hours, lab)**<br><br>A. Entrance Pupil<br>B. Exit Pupil<br>C. Figure<br>D. Vignetting<br>E. Rays<br>F. Waves<br>G. Diffraction<br>H. Contrast<br>I. Airy Diffraction Pattern<br>J. Airy Disk<br><br>**III. Optical Aberrations (1 hour, lab)**<br><br>A. Defocus<br>B. Spherical Aberration<br>C. Coma<br>D. Astigmatism |

| | |
|---|---|
| | E. Optical Scattering<br><br>**IV.Tests (7 hours, lab)**<br><br>A. Knife-edge<br>B. Foucault Tests<br>C. Couder Masks<br><br>**V. Collimation (2 hours, lab)**<br><br>A. Star Test<br>B. Light Baffles<br><br>**VI. Fabrication of a Telescope (40 hours, lab)**<br><br>A. Grind<br>B. Smooth<br>C. Polish Figure<br>D. Testing a Telescope Mirror |
| **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:** | Test the optical figure of your mirror, determine a technique to fix errors, perform the technique, and retest the optical figure to assess its new form. Submit your test results and explain how you will fix the errors. Also submit the re-evaluated test results. |
| **Critical Thinking Assignment 1:** | Construct a Foucault test diagram for your mirror, measure the zonal foci of the mirror and determine if your mirror meets the optical tolerances of the test. Submit the test diagram and zonal foci on the report sheet provided. In a few sentences, explain if your mirror meets the optical tolerances. |
| **Critical Thinking Assignment 2:** | Calculate the field-of-view, magnification, and the exit pupil for each eyepiece from the list provided. Determine which eyepieces provide the full illumination of your primary mirror and which ones are "wasting" light. Submit your calculations and a list of suitable mirrors to your instructor. In a short paragraph, give a reason for your selection of mirrors. |
| **Other Evaluation Methods:** | Fieldwork, Laboratory Reports, Written Homework |
| **Instructional Methods:** | Demonstration, Group Activities, Lab |
| **If other:** | |
| **Work Outside of Class:** | Course is lab only - minimum required hours satisfied by scheduled lab time |
| **If Other:** | It is not required for the student to work outside of class. However, it is highly recommended if the student wants a finished product by the end of the semester to put in about 3 extra hours outside of class per week. |

| | |
|---|---|
| **Up-To-Date Representative Texts:** | Jean Texereau, How to Make a Telescope, 2nd edition, Willman-Bell, 1984 (Discipline Standard) |
| **Alternative Texts:** | |
| **Required Supplementary Readings:** | |
| **Other Required Materials:** | $375 for materials and mirror glass/blank tool.<br><br>Mirror-making supplies include:<br><br>Abrasives (#120, #220, #320, SiC; 25µm, 15µm, 9µm, 5µm, A1203) Polish (CeO or Rouge)<br><br>Polishing pitch (medium burgundy or medium swedish) Miscellaneous cleaning supplies<br><br>Mirror cell<br><br>Secondary mirror<br><br>Secondary mirror holder<br><br>Spider<br><br>Focusser<br><br>Tube<br><br>Mount<br><br>Paint and finish |
| **Requisite:** | |
| **Category:** | |
| **Requisite course(s): List both prerequisites and corequisites in this box.** | |
| **Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).** | |
| **Requisite Skill:** | |
| **Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable** | |
| **Requisite course:** | Astronomy-20 or Astronomy-20H<br><br>Astronomy-25 or Astronomy-25H |

| | |
|---|---|
| **Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).** | **A knowledge of optics or experience with astronomical equipment will provide the necessary technical background for success in the course.**<br><br>**Students should be familiar with objects in the night sky that may be observed with the telescopes** |
| **Requisite Skill:** | Proficient in intermediate algebra skills |
| **Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable** | **Students should be able to do intermediate level algebraic calculations for measurements and calculations in the telescope construction and assembly.** |
| **Enrollment Limitations and Category:** | |
| **Enrollment Limitations Impact:** | |
| **Course Created by:** | Perry Hacking |
| **Date:** | |
| **Original Board Approval Date:** | 04/26/1993 |
| **Last Reviewed and/or Revised by:** | Shimonee Kadakia |
| **Date:** | 09/21/2023 |
| **Last Board Approval Date:** | 11/20/2023 |
| **Effective Term:** | FALL 2024 |