March 2011

ASTR 444 – Observational Astronomy (4)
Course Outline

Introduction to observational astronomy. Coordinate systems, telescopes and observational instruments (CCDs, filters, spectrographs), observational methods and techniques, data reduction and analysis. Laboratory activities include use of a telescope, CCD camera for data acquisition, data reduction and analysis, and presentation of results. 3 lectures. 1 laboratory. **Prerequisites:** ASTR 301 and ASTR 302, or consent of instructor.

This course in observational astronomy will complete the required course selection for students pursuing a minor in astronomy. Students minoring in astronomy should have exposure to the acquisition and analysis of actual astronomical data. In addition to providing this background, the course will serve as the capstone course for the minor, allowing student access to a telescope and experience working with the equipment and computer analysis techniques of a professional astronomer. The course complements the content material covered in ASTR 301/302/326.

Learning Objectives and Criteria:
The expected outcomes are:

(1) Understanding usage of astronomical equipment such as CCD cameras, telescopes, and spectrographs

(2) Understanding of astronomical techniques such as time-series photometry, spectroscopy, fitting PSFs, and data reduction

(3) Completion of data analysis of a specific astronomical object of study with a group

(4) Understanding of the field of astronomy and the role that observational astronomy and astronomical data play in our understanding of the universe

Text and References:

Birney, D. Scott, Gonzales, Guillermo, Oesper, David, *Observational Astronomy,* 2nd Ed, Cambridge University Press

Content and Method:
Method: ASTR 444 is offered in a traditional lecture format. It meets a total of 4 hours a week.

Content: ASTR 444 will adhere to the following topics:

1) Coordinate systems – Intro to telescope/CCD (at observatory).
   Measuring time – Students will investigate CCDs and how they work.
   Star catalogs
   Web sites

2) Telescopes: optics, design, ideal characteristics – Intro to telescope/CCDs (at observatory).
   Telescopes: problems, errors, solutions – Students will use a telescope to acquire target and collect data.

3) CCD cameras – Intro to astronomical software.
   Sources of noise in CCDs – Students will learn to use astronomical software such as IDL, IRAF.
   Spectrographs

4) Imaging – Intro to photometry.
   Image reduction – Students will learn to reduce stellar data.
   Filters

5) Photometry – Intro to photometry.
   Aperture, psf-fitting – Students will learn to analyze time-series photometry data.

6) Photometry – Data analysis
   Absolute, relative, time-series, color – Students will continue to investigate time-series photometric data.

7) Data analysis
   Error analysis – Students will analyze errors and uncertainties in astronomical data.
   Statistical techniques
   Statistical significance

8) Spectroscopy – Intro to spectroscopy.
   I-D, echelle, high resolution – Students will learn the basics of spectral reduction and analysis.
   Red/blue-shift measurements

9) Astronomy at non-visible wavelengths – Intro to radio astronomy.
   Space telescopes – Students will learn to reduce and analyze data from radio telescopes.

10) Adaptive optics – Presentation of results.
    Modern observatories – Students will present the results of their group projects.
    Observing non-photon particles

Lectures
The approach is on both a descriptive and quantitative basis, emphasizing the application of mathematics and of physical laws.

A student observatory with at least one telescope and attachments adequate for elementary investigations is available.

The student is expected to study the text and necessary references.

Methods of Assessment:
- Students will complete a final course project, consisting of group work in data analysis, a written report detailing their work and conclusions, and a class presentation of their results.
- Instructor observation, exams, and laboratory exercises.
- Examinations and completion of the main course project paper (paper would include details of the significance of their particular data in the field of astronomy).