June 2009

Astronomy 112 – Introduction to the Stars and Galaxies (4)
Course Outline GE B3 & B4

Prerequisites for ASTR 112 – None. Not open to students who have completed or are taking ASTR 102, ASTR 301, ASTR 302, or PHYS 132. ASTR 101 is not a prerequisite. 3 lectures, 1 activity Fulfills GE B3 & B4.

Descriptive astronomical properties of the sun, stars, galaxies and interstellar material. Exploration of cosmological models of an expanding universe. Laboratory activities will include real and virtual astronomical viewing and experiments.

Learning Objectives and Criteria:

Upon completion of the course the student is expected to:
a. Understand the language of astronomy.
b. Understand and use specific theories, laws and models which have proven to be useful in astronomy and physics.
c. Understand the basis of present knowledge in astronomy, and efforts underway to extend present knowledge.
d. Observe the sky and identify prominent constellations, stars and locations of major nebula. Identify common post-main sequence stars, explain their color and know their evolutionary stage.
e. Graph, analyze, and interpret various types of astronomical data involving spectra from stars, galaxies and quasars as well as planetary and stellar orbits.

Text and References:
"Universe", 8th edition by Freedman and Kaufmann III

Content: ASTR 112 will adhere to the following topics:

Week 1) Introduction to the course. Learn constellations and understand how the earth's rotation and orbit about the sun influences celestial viewing.

Lab 1*: Tour of the solar system and beyond, planetary and galactic distance scales. Students will take an introductory self-guided slide show of our solar system, our galaxy and the Universe. Students will complete an activity worksheet to learn about the relative sizes and distances to the planets in our solar system, our galaxy and the Universe.

Week 2) Kepler's and Newton's laws.

Lab 2: Constellations and celestial viewing. Using the Starry Night computer program students will identify constellations, prominent stars, the ecliptic, the influence of the earth's rotation and orbit about the sun on stellar motion, the Milky Way galaxy and its relation to the plane of the earth's orbit, the Andromeda galaxy and other important nebula. This virtual activity will serve as a basis for what the students are expected to understand when the weather is favorable for real celestial viewing.

Week 3) Light, spectra, blackbody physics, and the Doppler effect.

Lab 3: Lunar and solar eclipses. Students will use the Starry Night computer program and physical models to study the motion of the moon relative to the earth, sun and background stars. This knowledge will allow students to understand lunar phases, lunar eclipses and solar eclipses. Students will be able to identify upcoming lunar and solar eclipses.

Week 4) Properties of the sun including its atmospheric layers, interior, spectra, energy source, and sunspot cycle.

Lab 4: Kepler's laws and planetary orbits. Using astronomical data for Mars, students will plot the orbit and see that Kepler's laws are satisfied.

Weeks 4 and 5) Properties of stars including distance, luminosity, magnitude, surface temperature, spectral class, size and mass.

Lab 5: Sunspots, spectra and the sun's rotation rate. Students observe typical absorption and emission spectra using a spectroscope and diffraction grating. Students observe pictures of the sun with sunspots on the internet and notice how the sunspots move as the sun rotates. Using data of the sun's absorption spectra and the Doppler effect, students are able to determine the sun's equatorial rotational period.

Weeks 6 and 7) Star formation, age and evolution (red giants, planetary nebula, white dwarf stars, supergiants, neutron stars).

Lab 6: Determining a stars location on an H-R diagram. Using spectral data for a star, students can determine temperature using Wien's law. With the measurement of a star's apparent brightness and stellar parallax (used to deduce distance), students learn how to determine a star's luminosity. Determining a star's temperature and luminosity allows students to plot the star on an H-R diagram.

Lab 7: Stellar evolution. Students learn the processes taking place in stellar interiors during the various stages of a star's lifetime.

Week 8) Special relativity, general relativity and black holes.

Lab 8: Galactic rotation curves and dark matter. Using data from galaxies, students create galactic rotation curves and investigate the need to hypothesize the existence of dark matter.

Week 9) The Milky Way and other galaxies, galactic distances, dark matter, and quasars.

Lab 9 Age and expansion of the universe. Using redshift data for distant galaxies to determine recessional velocity, and distance determined from the period-luminosity relationship for Cepheid stars in the galaxies, a Hubble plot can be made. From the slope of the Hubble plot, the expansion rate of the Universe in the current epoch will be determined and an estimate of the age of the Universe will be made.

Week 10) Introduction to cosmology, evidence for the big bang and the large scale structure of the universe.

Lab 10: Lab Final

* Each of these lab activities will be conducted in the physics studio classroom. On nights with favorable viewing conditions (possibly two or three times during the fall or winter quarters), students will work outside to identify constellations, prominent stars, the ecliptic, the influence of the earth's rotation and orbit about the sun on stellar motion, the Milky Way galaxy and its relation to the plane of the earth's orbit, the Andromeda galaxy and other important nebula.

Method: ASTR 112 is offered in a traditional lecture/lab format

This is a 4-unit course with 3 lectures and 1 activity per week.
Lab activities will be held in the Physics department's studio classroom, using CD ROM's and the internet. Celestial viewing activities will take place in or near the physics department observatory using purchased telescopes.

Methods of Assessment:

Five short answer quizzes (20%), astronomy journal, lab exercises, and lab final (30%), one mid-term exam (20%), a comprehensive final exam (30%) will be used to assess student understanding of the presented material.

The writing performed by the students on the short answer quizzes and astronomy journal will constitute 25% of the final grade and will assess to what extent the student has met learning objectives.

The multiple choice mid-term and final exam will also assess to what extent the student has met the learning objectives.

The lab activities will focus more on assessing to what extent students have understood items a, b, d, and e in the expected learning outcomes of the course. The lab activities will be assessed by grading a weekly worksheet involving a mix of fill in the blank questions, short answer questions, worked out problems and graphical analysis. The written portion of these worksheets will constitute approximately 15% of the overall grade in the course.