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Course Outline for ASTR 30L

INTRODUCTION TO ASTRONOMY LAB

Effective: Fall 2018

I. CATALOG DESCRIPTION:
ASTR 30L — INTRODUCTION TO ASTRONOMY LAB — 1.00 units

Introduction to laboratory principles and techniques in astronomy. Includes: observational techniques such as naked eye, binocular, and telescopic identification of stars, planets, constellations, and deep sky objects; telescope operation and imaging; spectroscopy, motions of the sun, moon and planets.

1.00 Units Lab

Prerequisite
ASTR 10 - Introduction to Astronomy: The Solar System
(May be taken concurrently)
or

ASTR 20 - Introduction to Astronomy: Stars and the Universe
(May be taken concurrently)

Grading Methods:
Letter or P/NP

Discipline:
- Physics/Astronomy

	MIN
Lab Hours:	54.00
Total Hours:	54.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:

Before entering the course a student should be able to:

A. ASTR10
1. review and explain the Scientific Method, as it applies to astronomy;
2. describe and explain the celestial sphere and astronomical coordinate systems;
3. diagram and explain the apparent motion of the planets, moon, sun, and stars;
4. explain the daily and annual motions of the Earth and moon, including tides and eclipses;
5. appreciate the development of astronomical models throughout history, including models from Ancient Greece and Europe, as well the contributions and systems of from Meso-America, China, and the Middle East.
6. describe the types of astronomical tools and spacecraft used in exploration of the solar system;
7. describe current models for the formation and structure of the solar system, as well as the evidence in support of these models.
8. describe general distinguishing properties of Terrestrial and Jovian planets, as well as comets, meteors, and asteroids;
9. describe and identify the structure, composition, and basic physical properties of the Earth.
10. explain the process of the Earths structural and atmospheric evolution from the Accretion era to the present;
11. explain the role of catastrophic impacts in directing the formation and evolution of the Earth and Moon;
12. identify and describe on-going changes to the Earth's atmosphere and biosphere due to the evolution of life, and on-going human activities;
13. describe the structural, geological, and atmospheric properties of the terrestrial worlds, with particular emphasis on factors that led to similarities and differences with the Earth;
14. describe and identify the structural, atmospheric, and magnetic properties of the Jovian Planets;
15. describe the satellites and rings of the outer planets, as well as the processes responsible for their unique characteristics;
16. describe and identify the components and characteristics of the Asteroid Belt, Kuiper Belt, Oort cloud, and other small bodies in the solar system;
17. summarize the most recent spacecraft exploration of the solar system, as well as likely possibilities for future exploration;
18. describe the distinguishing characteristics of asteroids, comets, meteors, and meteorites;
19. explain the requirements for life in space and the scientific attempts to locate signs of intelligent life outside of Earth;
20. describe the current and future methods involved in the search for extra-solar planets, as well as the characteristics of recently discovered solar systems;
21. identify at least 10 different seasonal constellations and bright stars, as well as planets currently visible in the night sky.

B. ASTR20
1. review and explain the scientific method, as it applies to astronomy;

2. describe the Earth's position in the universe by comparing the scale and structure of the solar system, galaxies and universe;
3. describe the relation between the seasons, constellations, and motion of the Earth about the sun;
4. explain the nature of light as electromagnetic radiation;
5. describe the construction and uses of telescopes, spectrographs, and other astronomical tools;
6. describe the properties of our sun, including its structure, composition, and methods of energy production and transport;
7. describe and explain the relationship between energy production in the suns interior, and observable surface phenomena such as sunspots, flares, and magnetism;
8. identify the age, type, and composition of various types of stars, and summarize their evolutionary sequences
9. identify the constituents and properties of the interstellar medium;
10. identify and describe the structure, contents, and dynamics of the Milky Way galaxy;
11. describe the large scale structure and contents of the Universe;
12. describe competing cosmological models for the evolution of the universe, as well as contemporary evidence in support of each model;

IV. MEASURABLE OBJECTIVES:

Upon completion of this course, the student should be able to:

A. Write a laboratory report that identifies the processes of the scientific method applied to course experiments
B. Identify distances and sizes in the solar system
C. Identify and determine the angular diameter of an object
D. Identify ten bright stars and ten constellations visible during the semester
E. Locate, using binoculars and telescopes, at least five celestial objects (such as nebulae, star clusters, and galaxies) not normally visible to the naked eye
F. Describe the difference between, and conditions for, a solar and lunar eclipse
G. Use the concept of parallax to determine the distance to an astronomical object
H. Measure the angular separation of two objects using a sextant or other angular measuring instrument
I. Analyze problems using orbital mechanics and the Law of Universal Gravitation
J. Analyze orbital properties of a planet's moons to determine the mass of the planet
K. Explain the Doppler shift and its use in determining periods of rotation of planets
L. Explain the fundamentals of digital and/or analog image processing
M. Measure the wavelength of spectral lines commonly found in stellar spectra
N. Explain how telescopes use lenses and/or mirrors to form images
O. Align a telescope for proper operation
P. Use the method of spectroscopic parallax to determine distances to remote objects
Q. Identify the different types of galaxies by their structure
R. Explain how a CCD camera can image more distant features than a photograph
S. Explain how the Doppler shift may be used to create a Hubble Diagram and estimate the age of the universe
T. Determine the azimuth and altitude of the sun, moon and stars
U. Draw a sketch of a star's position on the celestial sphere when given that star's azimuth and altitude or its right ascension and declination
V. Plot the path of the sun, moon or planets on a star chart
W. Locate an object on a star chart when given its celestial coordinates

V. CONTENT:

A. Astronomy as a Science
B. Scaling and the Solar System
C. Naked Eye Observations and Sketches of the Moon and Night Sky
D. Circumpolar and Seasonal Constellations
E. Telescopic observations of selected objects
F. Celestial Coordinate Systems: Right Ascension and Declination, Altitude and Azimuth
G. Angular Diameter, Size and Distance
H. Studying Solar and Lunar Eclipses
I. Exploring Motions of the Heavens Using a Planetarium Program
J. Retrograde and Planetary Motions
K. Parallax and Astronomical Distances
L. Gravitation and Orbital Motion, Detecting Extra-Solar Planets
M. The Moons of Jupiter
N. The HR Diagram
O. Tracking Sunspots
P. Spectroscopy in Astronomy: Emission Spectra
Q. Lenses and Telescopes
R. Predicting Solar Eclipses
S. An Introduction to Digital Imaging: Surfaces of Solar-System Objects
T. Photoelectric Photometry of Star Clusters
U. Structure of Galaxies
V. Clusters of Galaxies
W. Hubble's Law and The Expansion of the Universe

VI. METHODS OF INSTRUCTION:

A. **Lab** - Three-hour laboratory session per week
B. **Demonstration** - Instructor demonstration Student participation in demonstrations
C. Student experimentation

VII. TYPICAL ASSIGNMENTS:

A. Laboratory Exercise
B. Computer Simulation
C. Observational Activity
D. Field Trip

VIII. EVALUATION:

A. **Methods**

1. Exams/Tests
2. Quizzes
3. Projects
4. Group Projects
5. Class Participation
6. Lab Activities

B. **Frequency**

1. Students are required to show up for and participate in every laboratory meeting.
2. In general, laboratory reports (either group or individual) will be handed in each week. Some laboratory exercises will cover two class meetings.
3. Quizzes may be given every few weeks at the discretion of the instructor.
4. A final laboratory exam will be given once at the end of the semester.

IX. TYPICAL TEXTS:

1. Chaisson, Eric, and Steve McMillan. *Astronomy Today.* 9th ed., Pearson, 2018.
2. Bennett, Jeffrey, Megan Donahue, Nicholas Schneider, and Mark Voit. *The Cosmic Perspective.* 8th ed., Pearson, 2017.
3. Kay, Laura, Stacy Palen, and George Blumenthal. *21st Century Astronomy.* 5th ed., W. W. Norton & Company, 2017.
4. LPC Faculty. Astronomy 30 Laboratory Manual. N/A , 2018.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

A. Computer access, through purchase of a Computer Use Card at LPC, or access to a personal computer at home or work with an Internet connection.
B. Flashlight
C. red observing light
D. durable star chart,
E. warm clothing strongly recommended.