

ASTR 604 Physical Foundations of Astronomy – Workshop for Teachers

Course Description

Lecture/Laboratory-oriented course that introduce middle and high school teachers to basic principles of physics presented in the context of modern astronomy and astrophysics. Fundamentals of mechanics and celestial mechanics and their applications to space exploration, as well as fundamental principles in optics and the structure of matter are discussed.

Prerequisite: Middle-School/High School Teachers

Not open to students who have Credit in PHYC 602

Course Objectives

1st Day:

Compare and contrast Aristotle's and Newton's mechanics;

Compare and contrast Ptolemaic and Copernican cosmologies;

State and explain Kepler's laws of Planetary Motion;

Describe Galileo's contributions to our understanding of motion and list his telescopic Observations;

State Newton's three laws of motion and identify examples of each.

2nd Day:

State and explain Newton's law of Universal Gravitation;

Explain tidal forces in terms of Newton's laws of motion and Universal Gravitation and provide examples of the actions of tidal forces in nature;

Explain orbital motion in terms of Newton's laws of motion and Universal Gravitation;

Define and compute least energy orbits and travel times for solar system travel;

Review the past achievements and current status of space exploration.

3rd Day:

Describe the quantitative properties of electromagnetic radiation using the wave model and the particle model of light;

Use the relationships between wavelength, frequency, the speed of light and the energy per photon to compute one of these variables when given others;

State Kirchoff's laws of spectral analysis and describe the physical conditions indicated by each law. Identify examples of each type of light source;

Discuss the need for two models used to describe light and the implications for science in general.

Compare and contrast the Planetary (Solar System) model and the Bohr model of the atom;

Explain how absorption lines and emission lines are produced in the Bohr model of the atom and how they relate to chemical composition;

Explain how motion affects the spectral lines from a source and describe how the relative line of sight speed is determined;

State the inverse square law of light and describe quantitatively how brightness of a light source changes with distance.

Compare modern concepts of matter with those of ancient Greek scientists.

Describe how refinements in models of elementary particles lead to convergence of definitions of matter and energy.

4th Day:

State the laws governing blackbody radiation and describe the connection between continuous spectra and temperature;

Describe the nature of the nuclear force and compare and contrast it with the electrical and gravitational forces;

Describe the structure of the nucleus of atoms and explain the stability curve for stable isotopes;

Compare and contrast nuclear fusion, nuclear fission and radioactivity;

List the major nuclear transformations which provide the energy for stars and indicate the nuclei involved in each;

Explain how ages of rocks are determined using radioactive decay and indicate the significance of the ages;

State the primary postulates of the special and general theories of relativity and explain the differences between predictions of these theories and those of Newtonian Mechanics;

Explain the three classical tests used to substantiate the general theory of relativity.

5th Day:

Describe the evidence used to support our current theories of how the Solar System formed moreover, indicate the significance of this theory on the probability of there being other planetary systems.

Discuss the current status of efforts to detect planets around other stars.

Course Rationale

This course has been designed to introduce teachers in Middle and High School to the terminology and concepts of the physical sciences used in modern astronomy and astrophysics. Lectures are designed to describe the fundamentals of mechanics and celestial mechanics and their applications to space exploration. In addition, fundamental principles in optics, structure of matter, and energy sources are also discussed.

Course Content, Format, and Bibliography:

Content

Course Topics	
1. Aristotle's & Newtonian Mechanics	6. The Nature of Light & Matter
2. Ptolemaic & Copernican Cosmologies	7. Spectroscopy
3. Kepler's Laws of Planetary Motion	8. Electrical & Nuclear Forces
4. Galileo's Experiments & Newton's Laws	9. Structure of Atom & Nuclear Energy
5. Special & General Relativity	10. Cosmogony & Exoplanets

Format

Class meets from 7:30-11:30 and from 12:30-5:00 from Monday through Friday. On Friday, lectures are scheduled until only 11:30 am. After lunch, time will be spent for review and questions. The Final Exam will be given from 2:45 to 5:00 PM. Anyone wishing to start the evaluation and closing before 2:45 on Friday should discuss this desire with the Dr. Jordan.

All reading assignments will be taken from the Course Manual the assigned textbook or will be provided. Reading assignments should be completed prior to attending class in order to make lectures and laboratory time more efficient and effective. Written assignments will be reviewed and discussed during the week to provide feedback on your performance in class.

Bibliography

Textbooks:

"*Physical Foundations in Astronomy Workshop for Teachers*" by Dr. Thomas M. Jordan

Foundations of Astronomy, 12th Edition by Michael A. Seeds and Dana Backman, Brooks-Cole/Cengage Publishing, 2013.