Astrophysics

Objectives:	00UV	**Discipline:**	Physics
Ponderation:	3-2-3	**Course Code:**	203-BZA-05
Prerequisite:	00UT (*Waves, Optics and Modern Physics*)	**Course Credit:**	2 2/3
Corequisite		**Semester:**	4

Introduction

Astronomy and Astrophysics is a Science Option course, designed for fourth semester science students, familiar with elementary classical mechanics, differential and integral calculus, and waves and modern physics. Using these tools, the course will give students a comprehensive introduction to astronomy and astrophysics, from ancient times to the present. Emphasis will be on the logic behind astronomical thinking, rather than on the memorization of facts.

Astronomy once seemed a rather esoteric and irrelevant pursuit. The Greeks believed that the Heavens and the Earth were two entirely separate places, obeying different physical laws. But with the theory of Copernicus, and the work of Kepler, Galileo and Newton, people came to understand that Earth is a tiny part of the Universe and that the same physical laws apply throughout. In the nineteenth century, great progress was made in measuring the properties of the stars. In recent decades there have been enormous advances in our understanding of the structure and evolution of stars, galaxies and the Universe itself. The Universe is a much more violent, complex and exciting place than we realized. We now see that there is a deep and intimate connection between astrophysical events, the chemical

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Objectives and Standards for *Astrophysics*

In the following chart, italicized items marked with (*) are optional enrichment items which will not be evaluated in the final exam (these are not the only possible enrichment items — they are the most commonly used ones).

OBJECTIVE	STANDARD	LEARNING OBJECTIVES

Elements of Competency	Specific Performance Criteria	Intermediate Learning Objectives
1. To apply previously acquired knowledge of physical and mathematical concepts to the study of astronomy from the ancient Greeks through the 19th century, with particular emphasis on solar system objects	1.1. Logical analysis of the characteristics of solar system objects, using ideas of ancient Greek astronomers	1.1.1. Explain the cause of the Moon's phases and the relation between phase and elongation, using diagrams. 1.1.2. Explain Aristotle's arguments for the sphericity of the Earth. 1.1.3. Calculate the relative Earth-Sun and Earth-Moon distances using Aristarchus' method. 1.1.4. Calculate the circumference of the Earth using Eratosthenes' method. 1.1.5. Describe Ptolemy's theory of the solar system. Explain how he accounted for the limited elongations of Mercury and Venus and for the retrograde motion of the superior planets. 1.1.6. Define parallax and use it to calculate the Earth-Moon distance.
	1.2. Logical analysis of the characteristics of solar system objects using the theory of Copernicus and the observations of Galileo	1.2.1. Describe Copernicus' theory of the solar system. Explain how he accounted for the limited elongations of Mercury and Venus and for the retrograde motion of the superior planets. 1.2.2. Define inferior and superior conjunctions, opposition, quadrature, sidereal period, and synodic period. 1.2.3. Derive the relation between the synodic and sidereal periods of a planet, and use it to calculate one of these quantities, given the other. 1.2.4. Use Copernicus' method to calculate the orbit sizes (in astronomical units) of the planets. 1.2.5. Describe Galileo's telescopic observations and explain how these observations support Copernicus' heliocentric theory.
	1.3. Proper use of Kepler's laws of planetary motion and the properties of an ellipse to calculate the parameters of an elliptical orbit	1.3.1. State and explain

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		1.5.3. Solve problems involving differential gravitational forces (tidal effects). Explain neap tides, spring tides and the variation of tidal amplitude with location. Discuss tidal effects outside the Earth-Moon system.
		1.5.4. Describe the different types of eclipses of the Sun and Moon, and explain their cause. Define and explain eclipse seasons and the Saros cycle.
	1.6. Careful analysis of effects resulting from the Earth's orbital revolution	1.6.1. Explain the aberration of starlight.
		1.6.2. Define the ecliptic, the equinoxes and the solstices. Explain their significance.
		1.6.3. Define the Arctic and Antarctic Circles and the Tropics of Cancer and Capricorn. Explain their significance.
		1.6.4. Explain the causes of the seasons. Draw diagrams and do calculations of the Sun's daily path at any latitude in any season.
	1.7. Careful analysis of effects resulting from Earth's daily rotation	1.7.1. Using diagrams, explain the daily motion of the stars as seen from different latitudes.
		1.7.2. Describe the coordinate systems of latitude and longitude, right

Elements of Competency	Specific Performance Criteria	Intermediate Learning Objectives
		star clusters.
	2.2. Accurate determination and description of the magnitudes,	

Elements of Competency	Specific Performance Criteria	Intermediate Learning Objectives
		the Hubble time to the age of the Universe. 4.2.3. Define the deceleration parameter q. 4.2.4. Define critical density and explain its importance. Make calculations using the formula for critical density. Discuss the "missing mass" problem and dark matter candidates. 4.2.5. Describe the theory of inflation and explain its importance. 4.2.6. Define and discuss the cosmic microwave background radiation. 4.2.7. Describe the evolution of the Universe over its first one million years, according to the standard Big Bang model. Describe alternative theories such as the old Steady State theory. Define the cosmological constant.
5. To verify experimentally some of the laws and principles associated with astronomy and astrophysics	5.1. Careful performance of the laboratory procedures provided	5.1.1. Work cooperatively in a small group to obtain data. 5.1.2. Employ safe procedures and show concern for one's own safety and the safety of others in the laboratory and while observing. 5.1.3. Exercise care in carrying out measurements to obtain the best results possible.
	5.2. Logical analysis of and appropriate mathematical treatment of data	5.2.1. Choose and apply appropriate mathematical, graphical and logical tools. **[00UU]**
	5.3. Coherent and justifiable conclusions	5.3.1. Understand and apply the principles involved in each experiment. 5.3.2. State clearly the conclusions to be drawn from one's analysis and justify them.
	5.4. Proper adherence to course norms for submitting laboratory reports	

Methodology

Astronomy and Astrophysics is presented in a series of lectures, labs and demonstrations. Emphasis is placed on applying scientific principles and mathematical techniques mastered in previous courses in the science program to the understanding of the historical development of astronomy and to current problems in astrophysics. Students are also required to make some astronomical observations as part of the laboratory component of the course.