This course description is subject to change and any changes will be posted in the Announcements section of your eConcordia portal.

Disclaimer: In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change.

About this course

Instructor: Dr. Mario D'Amico

Instructor Contact Information: phys284@econcordia.com

This email address allows you to contact the Professor directly. If you have any questions or concerns about the course that are specific to you, or if there is a delay in hearing back from your TA, please do not hesitate to use this email.

TA Contact Information: available through the course website

Course Description

Physics 284 - Introduction to Astronomy: This course provides an introduction to major topics in astronomy. The journey begins with a description of our planet, its place in the solar system, and resulting seasonal changes, tidal movements, and earth’s precession. Farther out, the solar system, the planets, star clusters, the Milky Way galaxy, and other modern strange systems are explored. The physical, theoretical and experimental grounds for our understanding are explained including Newton's laws, quantum and relativistic theories of light and matter, the science of visual and radio telescopes, and techniques for discovering the existence of other planets in the Universe. The course concludes with a description of the Big Bang theory and addresses the question of the existence of life beyond earth.

Methodology

This course is primarily (70%) about facts of Astronomy. No prior knowledge of mathematics or physics is required. Every concept will be described from basic principles and although mathematical formulas are occasionally mentioned, the student is only required to understand the qualitative nature of a formula and is not expected to perform arithmetic calculations in this course. In addition to facts, the student is required to apply mental concepts (30%) from mathematical and physical notions to form judgments about concepts in Astronomy (for example, whether a star is visible in the northern hemisphere given its celestial coordinates).

Course Material

The material for this course consists of the required online textbook and the PHYS 284 – Introduction to Astronomy course website which includes the practice and graded quizzes, videos, discussion board and other course material.

The only text required for this course is available through the course website and is included in the online material fee.
Textbook


Course Website

The course website can be accessed at www.econcordia.com

Your eConcordia account will be valid until the end of the term for which you are registered.

Your account will allow you to access the online course material, which includes videos, notes, discussion boards, all graded course components, useful links, readings and many more resources from the course website for the duration of the term.

Topics

The course is divided in four parts. Part I deals with the foundations of Astronomy and addresses questions such as “what do we know about the Universe?”, “how did we arrive at these conclusions?”, and “how did Astronomy contribute to modern science?” In part II we describe the science used to infer properties of celestial objects. Topics include the physics of matter and light and the technology of Astronomy including telescopes, and machines of space exploration. In Part III, we explore our solar system, the planets, asteroids, comets, meteorites, and dwarf planets. Finally, in Part IV, we venture beyond the Solar System and look at the stars, galaxies and clusters. We conclude Part IV with a discussion of Cosmology, the theory of how the Universe began, and a discussion on the prospects of life in the Universe.

PART I: THE FOUNDATIONS OF ASTRONOMY

1. A Modern View of the Universe: This first lecture presents an overview of the Universe including its size, structure, evolution and an overview of the motions of celestial object in the universe. In addition, a brief outline of key events in the history of Astronomy will be presented. The goal is to provide a broad understanding of Astronomy as understood from our planet’s vantage point, to help place later lectures in context.

Week 1 Chapter 1 “A Modern view of the Universe”

2. The View from Earth: Our daily experiences including weather and seasonal changes, the phases of the moon, and the patters of objects seen in the night sky are all consequences of earth’s configuration in space. This sections describes why seasons occur, how patterns in the sky change throughout the year, how the moon phases change daily, and how eclipses occur. Several mathematical concepts needed for the proper understating of astronomy will be elucidated, including the notion of elliptical orbits, parallax, a celestial sphere, celestial coordinates, and the concept of waves and interference. Students will learn to imagine a three-dimensional world where complex motions are created from very simple basic principles.

Week 2 Chapter 2 “Discovering the Universe for Yourself”

The Development of Science: This section explores the history of astronomy from ancient times were a geocentric view dominated; to medieval times and enlightenment times where science developed and our understanding changed to a heliocentric view. Modern astronomy and role of modern physics is explained. By the end of this section, student will have a sense of how we arrived at our present understanding and what the role of the scientific method is.

Week 3 Chapter 3 “The Science of Astronomy”
(Optional) Chapter S1 “Celestial Timekeeping and Navigation”
PART II: THE SCIENCE OF ASTRONOMY

4. Physics of Matter: This lecture introduces physical notions of motion needed for a proper understanding of dynamics in Astronomy. We discuss acceleration, the definitions of force and momentum, how mass and weight differ, Newton's laws of motion and conservation principles such as conservation of angular momentum, conservation of energy, along with a discussion of the various forms of energy. With this, the pieces now are all in place to introduce Newton's universal law of gravitation and describe how Newton explained and expanded on Kepler's laws. Finally, we apply Newton's universal law of gravitation to explain fundamental ideas in astronomy, including orbital energy and changes, escape velocity, tides, and the acceleration of gravity.

Week 4
Chapter 4 “Making Sense of the Universe: Understanding Motion, Energy, and Gravity Astronomy”
(Optional) Section S2.1 “Einstein’s Revolution”
(Optional) Section S3.1 “Einstein’s Second Revolution”

5. Physics of Light: Much of what we know about astronomy has come from our visual observations – hence the light received from distant objects. This lecture focuses on the nature of light and matter, so that students can understand how we interpret the messages carried by light. We begin with a section on light in everyday life. Then we define basic terminology such as power, spectrum, emission, absorption, transmission, and reflection and introduce several important concepts including: wave properties of wavelength, frequency, and speed; wave-particle duality; the idea that light comes in the form of photons; the concept of a field; and the idea of light as an electromagnetic wave, the Doppler effect and light spectra.

Week 5
Chapter 5 “Light and Matter: Reading Messages from the Cosmos”
(Optional) Section S4.1 “The Quantum Revolution”

6. Telescopes, Technology, and Exploration: Telescopes are the most basic instruments of Astronomy. This lecture focuses on telescopes and their uses. We begin with a section on “everyday” light collection, discussing the human eye and cameras. We next look at the general design of optical telescopes, emphasizing two principal properties of telescopes: light-collecting area and angular resolution. We then turn to the atmospheric effects due to light pollution and turbulence (twinkling), leading to a discussion of how observing sites are chosen and a discussion of adaptive optics. We end the lecture with a brief overview of the use of spacecraft in planetary exploration including: robotic spacecraft’s, Earth orbiters, flybys, orbiters (of other worlds), and probes/landers. Students will gain an appreciation for the key differences among the different types of missions.

Week 6
Chapter 6 “Telescopes: Portals of discovery”
Section 7.3 “Space Exploration of the Solar System”
(Optional) https://www.britannica.com/topic/space-exploration
PART III: THE SOLAR SYSTEM

7. Features and Formation of the Solar System: This lecture offers an introduction to our solar system. We begin by mapping the broad features of the solar system and then focus-in on individual worlds, taking a tour of the Sun and the planets. The bulk of the lecture revolves around a single, unified theory for solar system formation. It essentially "builds" the solar system piece by piece so that the following lectures can look in detail at how those pieces work and interact with one another. This will also set the stage for the changes to the theory necessitated by the discovery of extrasolar planets discussed in the last lecture.

Week 7
Section 7.1 "Studying the Solar System"
Section 7.2 "Patterns in the Solar System"
Chapter 8 “Formation of the Solar System”

8. Terrestrial Planets: This lecture covers the terrestrial worlds: Mercury, Venus, Earth, Mars, and the Moon, their surfaces, atmospheres, and interiors. The goal is to use Earth as our prototype for most of the features and processes that occur on terrestrial planets and emphasize a comparative planetology - we discuss the processes that have occurred on each world with an eye toward giving students an understanding of why they happen, rather than on memorizing what features the processes have created. We end with an emphasis on the uniqueness of the geology and atmosphere of our planet and discuss the important topic of climate change including how Earth's climate stays relatively stable and how human activity is changing our planet.

Week 8
Section 9.1 “Connecting Planetary Interiors and Surfaces”
Section 9.6 “The Unique Geology of Earth”
Section 10.1 “Atmospheric Basics”
Section 10.6 “Earth’s Unique Atmosphere”

9. Jovian Planets: The jovian planets are very different from Earth. This lecture covers the four jovian planets and their satellites and rings. We do not cover all satellites, sticking instead to the most important or most curious. In addition to exploring the most interesting cases, such as Io, Europa, Titan, and Enceladus, we emphasize the idea that even frigid, icy bodies undergo a surprising amount of geological activity. Regarding rings we emphasize how rings work, including tidal forces and orbital resonances, and the origin of the rings.

Week 9
Chapter 11 “Jovian Planet System”

10. Asteroids, Comets & Dwarf Planets: Small bodies in the solar system are important for two reasons: for what they tell us about the formation of the solar system, and for what they can do to planets if they collide with them. This lecture connects these two subjects with an exploration of how comets and asteroids have been nudged by the jovian planets ever since their formation. While our understanding of asteroids has improved steadily in recent years, the study of comets has undergone a major breakthrough in the discovery of Kuiper belt objects. This discovery has helped put Pluto and Eris in context as the largest free-roaming Kuiper belt objects. The lecture ends with the topic of "cosmic collisions", the possible threat of an impact, and the role that impacts have played in biological evolution and our very presence on the planet.

Week 10
Chapter 12 “Asteroids, Comets, and Dwarf Planets”
PART IV: THE STARS AND BEYOND

11. **Stars, Star Clusters & The Milky Way**: In this lecture we position our solar system as one among a 100 billion stars in our Galaxy. Having developed a good understanding of our planet and the solar system, we now take our place in the grand scheme of things. We begin by revisiting the Sun, but this time as a star. Next we study stars, their classifications, the different types of stars and stellar evolution. We then venture out into our Galaxy – the Milky way – a relatively large galaxy and one of the three largest members of a few dozen galaxies in our Local Group of galaxy clusters.

Week 11  
Section 14.1 “A Closer Look at the Sun”  
Chapter 15 “Surveying the Stars”  
Section 19.1 “The Milky Way Revealed”

12. **Cosmology & Life in the Universe**: This lecture answers two very important questions - questions that are at the very heart of why we study Astronomy: How did the Universe begin? Is there life beyond our planet? We begin by studying what the movement of the distant Galaxies tells us about the origins of our Universe and how Hubble’s law reveals an expanding Universe. We then go through a timeline of the modern theory of how the Universe formed – the Big Bang Theory. Finally, we turn to the fascinating topic of life in the universe, the search for life in the solar system, the science of extrasolar planets, the SETI project, interstellar travel, the Drake equation, and to Fermi’s paradox.

We are at the dawn of space exploration and the importance of Astronomy grows every day - as we venture out into space searching for answers?

Week 12  
Section 20.1 “Islands of Stars”  
Section 20.2 “Measuring Galactic Distances”  
Section 22.1 “The Big Bang Theory”  
Section 13.1 “Detecting Planets Around Other Stars”  
Chapter 24 “Life in the Universe”

**Important Information**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Integrity</td>
<td>Academic Integrity</td>
</tr>
<tr>
<td>Academic Integrity Quiz</td>
<td>How to take the quiz</td>
</tr>
<tr>
<td>Access Centre for Students with Disabilities</td>
<td>ACSD</td>
</tr>
<tr>
<td>Concordia Library Citation &amp; Style Guides</td>
<td>Citing - Help &amp; How-to</td>
</tr>
<tr>
<td>Course Communication Tools</td>
<td>Communication</td>
</tr>
<tr>
<td>eConcordia Policies</td>
<td>Policies</td>
</tr>
<tr>
<td>Final Exams Information</td>
<td>Final Exams</td>
</tr>
<tr>
<td>Helpdesk/Support</td>
<td>FAQ</td>
</tr>
<tr>
<td>Refunds</td>
<td>Refunds</td>
</tr>
<tr>
<td>Technical Requirements</td>
<td>Technical Requirements</td>
</tr>
<tr>
<td>Tips for Studying Online</td>
<td>Studying Tips</td>
</tr>
</tbody>
</table>