EAS 100 – Planet Earth
Lecture Topics Brief Outlines

V. Astronomy Section

1. Introduction, Astronomical Distances, Solar System

Learning objectives: Develop an understanding of Earth’s position in the solar system and the universe; address the three challenges to understanding astronomy concepts; determine how astronomical distances are calculated; tour the solar system.

Reading: 419-451, 458-460

Figures to study: Text, Figures 16.2, 15.4, 15.9, 15.10, 15.13, 15.14, 15.16, 15.17, 15.18, 15.19, 15.21, 15.23, 15.25, 15.28, 15.29, 15.46

Topics:

Why astronomy? Earth’s place in universe; origin of universe; natural interest in observing night sky.

Problem in understanding astronomy concepts – scale; frame of reference; large numbers (vast distance and time, unfamiliar units).

Scale of the universe – what is a light year?

Galileo and the Moons of Jupiter – showed that objects could orbit another planet, not the Earth and thus supported Copernican theory of the solar system.
Tour of the solar system – terrestrial and Jovian planets; planetary orbits; features of the planets; asteroids, comets.

Viewing the night sky – absolute and apparent magnitude (brightness); the magnitude scale.

Measuring distances to stars (and galaxies) – 1. The parallax method – stellar parallax.

Measuring distances to stars (and galaxies) – 2. The brightness method – $1/r^2$ relationship; variable stars (Cepheid variables).

The Sun – example of a “typical star” – interior structure of Sun; contains 99.8% of the mass of the solar system (most of the remainder is Jupiter); radius of the Sun is 109 times the radius of Earth; one of 100 billion stars in the Milky Way; fewer than 5 percent of the stars in the Milky Way are brighter or more massive than the sun, but some stars are more than 100,000 times as bright as the sun, and some have as much as 100 times the Sun's mass; the temperature of the Sun’s surface is about 5800 K (~5500 °C); sunspots and the sunspot cycle.
The solar spectrum (electromagnetic radiation at various wavelengths) and surface temperature – “blackbody radiation.”

2. Stellar Evolution

Learning objectives: Understand the evolution and life cycle of stars; the methods of study of stars; the main properties of stars; the EM spectrum of stars; the Hertzsprung-Russell diagram; the proton-proton chain reaction and nuclear fusion in stars.

Reading: Text, pages 458-471

Figures to study: Text, Figures 16.2, 16.7, 16.10, 16.11, 16.12, 16.14

Topics:

Methods of study of stars – Tools of Astronomy (How do we know what’s out there?) – Samples (meteorites); photography (telescopes, satellites, radio telescopes); measuring distance (stellar parallax, brightness/Cepheid variable stars, Hubble red shift); spectroscopy (electromagnetic spectrum).

The life cycle of stars – the Hertzsprung-Russell (H-R) diagram.
The electromagnetic spectrum of stars – blackbody radiation and surface temperature.

Nuclear fusion in stars – the proton-proton chain reaction (and other nuclear reactions [CNO] in large stars).

3. Galaxies and Deep Space

Learning objectives: Galaxies and scale of the universe, the Doppler effect, Hubble red shift and calculating distances to galaxies in deep space, cosmology and the expanding universe, cosmic background radiation; Black Holes; the Big Bang Theory.

Reading: Text, pages 469-477


Topics:

Properties of galaxies.

Galaxies in deep space – the scale of the universe and distribution of galaxies.
The Doppler effect.

Hubble red shift – distance measurement for deep space; expanding universe.

Cosmic background radiation.

The Big Bang theory of origin of the universe.

Black holes.