Ay145 Topics in Astrophysics

Spring 2005

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The goal of this course is to provide astronomy and physics concentrators with a more advanced view of astrophysics which includes astrophysical processes and principles. We will do this by first covering relatively basic material but with an eye towards observational limitations and uncertainties. We will then cover a broad but selected set of topics that will range accross stellar evolution, star formation, the interstellar medium, cosmology and extragalctic astronomy.

Course Outline

I. Introduction
- The Philosphy of Astrophysics
- Definitions and Units
- Astronomical Limitations

II. Astrophysical Laws
- A. Radiation
  - Black-Body Radiation
  - Radiative Transport
  - Absorption
  - Emission
  - Thermal Equilibrium
- B. Gravity
  - Conservation Laws
  - Orbits
  - Virial Theorem
  - Hydrostatic Equilibrium

III. Stellar Physics
- A. Stellar Structure
- B. Stellar Evolution
  - The Hertzsprung-Russell Diagram
  - Better Living Through Chemistry
  - First Light
- C. Star Formation
- D. End Games
  - White Dwarves
  - Neutron Stars
  - Black Holes

IV. Interstellar Medium
- A. Components of the ISM
- B. Heating and Cooling
- C. Gas Dynamics
  - Shocks
- Magnetic Fields

V. Cosmology
- A. Basic Principles
- B. Models
  - The Hot Big Bang
  - Inflation
- C. Cosmological Parameters
  - Expansion Rate — The Hubble Constant
  - Dark Matter — Ω
  - Large-Scale Structure
  - Backgrounds
  - The Accelerating Universe — Λ and/or Dark Energy

VI. Galaxies
- A. Morphology
  - Ellipticals
  - Spirals
- B. The Milky Way as an Example
  - Rotation
  - Density Waves
- C. Populations
- D. Evolution
- E. Active Galactic Nuclei

Coursework:

Problem Sets $\sim$ every week, 40% of the grade
Midterm Project, 20% of grade
Class participation, 10% of the grade
Final Exam, 30% of the grade

Texts:

Required:

An Introduction to Modern Astrophysics, Carroll & Ostlie, 1996.

Recommended:

The Physical Universe, Shu, 1982.
The New Cosmos, Unsold & Baschek, 2002.

Other materials will be provided, including reference list for problems and projects.