Welcome to Astronomy 101

Course Instructor:
Prof. Darren L. DePoy

Suggested Textbook:
Bennett, Donahue, Schneider, & Voit:
The Essential Cosmic Perspective, 7th edition

Web Site:
http://faculty.physics.tamu.edu/depoy/astr101.html
Textbook

*the Essential Cosmic Perspective*

by Bennett, Donahue, Schneider, & Voit

7th edition

Readings will be from Chapters 1 through 18

- Will be skipping some extraneous or overly detailed sections.
- Readings are assigned by topic rather than by lecture
- Lecture sequence may not follow book
In-Class Exams

3 in-class exams:

- On the material since the last exam
- closed-book, closed-notes
- Comprise 60% of course grade
- graded on a curve
- 11 February, 10 March, & 14 April
- Makeup exams will be different
Final Exam

• Comprehensive & Cumulative
• Closed-book, Closed-notes
• Tuesday, May 10 8-10am
• Worth 30% of final course grade.

No Makeup Finals!
In-class assignments/Homework

• Problems and exercises that extend material covered in class
• Cooperative and collaborative work encouraged
• Worth 10% of final course grade
• Any assignments turned in late will not be accepted
Course Website

http://faculty.physics.tamu.edu/depoy/astr101.html

Contents

• All course handouts
• Online Lecture Notes
• Quiz results
  • Not individual, but ensemble performance and curve
• Links for Further Exploration
• Should be up and active by Thursday
Online Lecture Notes

Outlines of the electronic overheads shown in class.
Posted to the website each week in advance.
Includes lecture graphics & computer animations.
They’re free...
Office Hours, etc.

Office Hours: TTh 10-11:30am
Offices: MIST 420, Munnerlyn 204
E-mail is much better!
   depoy@physics.tamu.edu
Guaranteed prompt answers to all questions big or small!

Teaching Assistant is Yuan Wenlong
yuanwenlong@amu.edu
TTh 2:00-4:00
MIST 317
Lecture 1: Introduction

Astronomy 101
What is astronomy?

“astron” = star
“nomos” = law

Astronomy is the science of stars and clusters of stars, galaxies and clusters of galaxies, planets, “dwarf planets” and their satellites, asteroids and comets, interstellar gas and dust, and everything else in the Universe

A lot to cover in one semester...
“The most incomprehensible thing about the Universe is that it is comprehensible.”

Albert Einstein
“It will seem difficult at first, but everything is difficult at first.”

Miyamoto Musashi

The Book of Five Rings
Three Questions:

1) *What is it?*
   – Describe it: how bright, far, energetic, etc.

2) *How does it work?*
   – Underlying Physics (testable theories)

3) *How does it evolve?*
   – How does it form, develop & end its existence?
Main Topics:

- The Night Sky
- History of Astronomy & Science
- Light and Matter
- The Solar System
- Structure and Evolution of Stars
- Structure and Evolution of Galaxies
- Structure and Evolution of the Universe
- Frontiers of Modern Astronomy
The Night Sky
The Night Sky

- Observed motions of the sky
- Definitions of day, year, etc.
- Seasons
- Navigation
- Long term changes
History of Astronomy
The History of Astronomy

• Ancient Observatories and Measurements
• Tycho, Kepler, Copernicus
• Galileo
• Newton
• Development of the Scientific Method
Light and Matter
Light & Matter

• Light
  – Photons
  – Wavelengths and energies

• Matter
  – Fundamental particles

• Forces
  – Four fundamental forces
The Solar System

• Terrestrial planets
• Jovian planets
• Other stuff
  – Asteroids
  – Comets
  – Dwarf planets
• Formation of the Solar System
The Structure and Evolution of Stars
The Structure & Evolution of Stars

• Observed properties of stars
  – distances, motions, brightness, temperature, etc.

• Physics of stars
  – internal structure
  – sources of energy

• Stellar Evolution
  – formation, development, and final states
The Structure and Evolution of Galaxies
The Structure & Evolution of Galaxies

• Observed properties of Galaxies
  – distances, sizes, shapes
  – constituents (stars, gas, and dark matter)

• Physics of Galaxies
  – structure and dynamics

• Evolution of Galaxies
  – star formation histories
  – interactions with other galaxies
The Structure and Evolution of the Universe
The Structure & Evolution of the Universe

• Observed Characteristics
  – size, age, constituents

• Physics of the Universe
  – space, time, and gravitation

• Evolution of the Universe
  – origin of the Universe
  – development (Big Bang theory)
  – fate of the Universe
Frontiers of Modern Astronomy
Frontiers of Modern Astronomy

• What is Dark Matter and Dark Energy?
• Are there other planets in the Galaxy?
• Are There Giant Black Holes in Galactic Nuclei?
Lecture 1: Introduction
The Challenges of Astronomy

• We can’t “touch”, we can only observe.

• Vast, unbridgeable distances
  – hard to measure distances accurately
  – sometimes hard to measure distances at all!

• Long times (millions & billions of years)
  – properties of “populations” of objects
  – cosmic “lookback”: distance=time
Planet: The Earth

13,000 kilometers across
Satellite: The Moon

380,000 kilometers away
3,500 kilometers across
Star: The Sun

150 million kilometers away
1.4 million kilometers across
Cluster of Stars: The Pleiades

430 light-years away
15 light-years across
Gas & Dust: The Lagoon Nebula

5000 light-years away
50 light-years across
Galaxy: The Andromeda Galaxy

2,200,200 light-years away
80,000 light-years across
Cluster of Galaxies: Coma

320 million light-years away
10 million light-years across
A Sense of Scale

proton \(10^{-15}\) m
hydrogen atom \(10^{-10}\) m
thickness of human hair 18 to 180 microns \((10^{-6}\) m\)
human 2 m
medium sized town 10 km \((10^4\) m\)
Earth diameter                      \( \sim 10^4 \text{ km} = 10^7 \text{ m} \)
distance from Earth to Sun        \( 1.5 \times 10^{11} \text{ m} \)
distances to nearest stars        \( 10^{17} \text{ m} \)
size of Milky Way galaxy           \( \sim 10^{21} \text{ m} \)
Local Group of galaxies             \( 5 \times 10^{23} \text{ m} \)
radius of observable universe      \( 1.4 \times 10^{26} \text{ m} \)

Sometimes we like to use different units:
1 mile = 1.609347 kilometers
mean Earth-Sun distance = 1 Astronomical Unit
1 light-year = distance that light travels in one year (roughly 6 trillion miles)
Will define a new unit called a “parsec” that will be useful
Roughly 3 light-years

Will discuss objects that are very close to as far away
As possible to get: 13 Billion light years!