Introduction to Astronomy
A113

Andrew Connolly
Physics and Astronomy
406 Allen Hall
Phone: 624 1345
email: connolly@tiamat.phyast.pitt.edu

Class meets

MWF 3:00 to 3:50
Thaw 102

Office Hours

Monday 11:00 - 12:00pm
Friday 11:00 - 12:00pm
(or by appointment)

- **Goals of the Course:**
  - **To understand what makes the Universe so ordered.**
  - **To learn about how stars and galaxies form, age and die.**
  - **To learn about the expanding Universe and its fate.**
  - **Most of all to have fun - astronomy is uncovering new discoveries all the time.**
- **Text Book:**
  - **UNIVERSE (5th Edition)**
    - **by Kaufmann and Freedman (W. H. Freeman and Company)**
  - **Other Useful textbooks**
    - **Astronomy -- The Cosmic Perspective by M. Zelik and J Gaustad**
    - **Exploration of the Universe by Abell, Morrison and Wolf**
    - **Explorations: An Introduction to Astronomy by T. T. Arny (A0089 text)**
    - **Astronomy: From the Earth to the Universe by J.M. Paschoff (A0089 text)**

- **Course Description**
  - **A self contained course designed to introduce students to the basics of astrophysics. Course has a high descriptive content extensive use of math and geometry. Minimal calculus is required.**

    Allergic to math? You may prefer A089 (much more descriptive).
- **Major topics:**
  - **Fundamentals of Astronomy**
    - **Positions and motions of stars, the moon and the planets on the sky.**
  - **Birth and Evolution of Stars**
    - **Formation of stars and black holes**
  - **Galaxies and Cosmology**
    - **How the Universe evolved and what is its ultimate fate.**
- **Research Opportunities**
  - **New discoveries can be made by <u>you</u>**

- **Assigned Reading:**
  - **A: Introduction, Chapters 1 -- 7**
  - **B: Chapters 18 -- 24**
  - **C: Chapters 25 --29**
- **NB:**
  - **1. Chapters 8-17 (which deal with the solar system in detail) will not be covered in the course (or examined).**
- **Study Technique:**
  - **Read Chapter BEFORE lesson.**
  - **Note taking in class.**
  - **Copies of the transparencies will be given out at the end of each Chapter.**
  - **Review the core ideas at the end of each chapter - revise notes.**
  - **Do the review and advanced questions (exams will be similar to these)**
- **Overheads will be on the web**

http://www.phyast.pitt.edu/~ajc/teaching/a113.html

Exam Policy

- **Students MUST bring their ID cards to exams.**
- **Two exams will be given.**
  - **75% of the grade will be based on the exams.**
  - **All exams are compulsory**
    - **If an exam cannot be taken I must be told prior to the exam.**
    - **If a valid excuse (given in writing) is made arrangements will be made to give an exam on an alternate day (if possible).**
- **First exam (Mid term)**
  - **will cover the first half of the course.**
  - **will count for 25% of the grade.**
- **Second exam (Final)**
  - **will cover all the course but will focus on the second half.**
  - **will count for 50% of the grade.**

Exam Questions

- **Exam questions will vary in style, and may consist of**
  - **1. Short questions examining key ideas, concepts, and definitions.**
  - **2. Essay questions: These may be short (for example, an explanation of a scientific term) or may require a detailed discussion of some astronomical theme.**
  - **3. Mathematical problems requiring formulation of the problem, and its solution. With these problems the working must be shown to gain credit.**

- **I will confirm the examinable material the week before the exam.**

Homework

- **Regular assignments**
  - **Every 2 weeks.**
  - **They are due back the following week.**
  - **For every day late 14% of the grade will be deducted.**
- **Homework: a learning experience**
  - **It helps you and I gauge how you are doing with the classes.**
  - **Dont copy someone else's work. If you have a problem come and see me.**
  - **No marks will be deducted for discussing the problem with me.**
  - **Points will be deducted for untidy work.**
- **Exam questions will be similar to homeworks**
  - **It is important that you understand the problems and not just the answers.**
- **Show how you came to an answer**
  - **Dont just write the answer show the workings (workings must be shown for credit to be given).**
  - **Write you answers in pen.**

- **Grading Summary**
  - **Exam 1: 25%**
  - **Final Exam : 50%**
  - **Homework: 25%**

- **Holidays**
  - **Monday Sep 6 -- Labor day**
  - **Nov 24-Nov 28 (Wed-Sun) -- Thanksgiving holiday**

Section A (Chapters 1 -- 7)

- **Introduction [Ch. 1]**
  - **Philosophy of Science. Powers of 10. Unit conversions. Basic astronomical units. Angular measures. Inventory of Universe. Size-scales in Astronomy.**
- **Knowing the Heavens [Ch 2]**
  - **Constellations. The Celestial Sphere. Diurnal motion of the stars. Ecliptic, Celestial poles and equator, Seasons and their causes. Precession and its causes. Solar and Sidereal time. Difference between solar and sidereal days. Universal time, international date line, leap year (meaning and why needed). Astronomical coordinates.**
- **Eclipses and Motion of the Moon [Ch 3.]**
  - **Phases of the moon. Eclipses. Lunar and Solar eclipses. Sidereal and Synodic months.**
- **Gravity and Motions of Planets[Ch.4]**
  - **Planetary motion. Kepler's Laws. Inertia. Newton's laws. Law of Gravity. Mass. Weight. Escape velocity. Conservation of Energy, Conservation of angular momentum.**

- **The Nature of Light and Matter [Ch. 5]**
  - **Nature of light. Basic properties (wavelength, energy, types). Refraction and dispersion. Black-Body Spectrum (Planck Function). Wien's law. Stefan-Boltzmann Law. Types of spectra and their production. Structure of atom and energy level diagrams. Doppler shift and its use.**
- **Optics and Telescopes [Ch 6]**
  - **Types of telescopes (Reflecting, Refracting, Schmidt), Radio telescopes. Resolving power - dependance on wavelength and telescope diameter. Focal length. Magnification. Focal ratio. Aberrations.**
- **Our Solar System [Ch. 7] (not covered in class)**
  - **Private reading (& homework)**
  - **Types of planets (Terrestrial and Jovian). Basic properties (order from Sun, relative sizes, densities, composition). Formation of solar system.**

Section B: (Chapters 18 -- 24)

- **Our Star - The Sun [Ch. 18]**
  - Structure of Sun, energy generation (proton-proton chain), energy transport (radiation, convection, conduction). Solar surface features (sunspots, flares etc) . Solar cycle --- causes and effects. Solar neutrinos, Solar seismology.
- **Nature of Stars [Ch. 19]**
  - Stellar distances, stellar motion. Apparent and absolute brightness. Parallax, Inverse square law, and their uses. Apparent and absolute magnitudes. Luminosity. Color of stars. Stellar Spectra. H-R diagram. Binary stars and their use. Stellar masses and sizes. Spectroscopic and eclipsing binaries. Luminosity classes.
- **Birth of Stars [Ch. 20]**
  - Interstellar gas and dust. Interstellar extinction (reddening). Protostars. Young stars. Bipolar flows. Processes that trigger star formation. Main sequence. Interstellar molecules. HII regions.

- **After The Main Sequence [Ch. 21]**
  - **Principles of stellar evolution, Life expectancies, Difference in evolution between low and high mass stars. Red giants. Helium burning. Tests of stellar evolution. Stellar ages from observations of clusters (the HR diagram). Mass-Loss. Binary evolution.**
- **The Death of Stars [Ch. 22]**
  - **Evolution of low-mass stars. Planetary Nebulae, White dwarfs and the Chandrasekhar limit. Evolution of high mass stars. Supernovae explosions. Creation of the elements. Supernovae from White dwarfs in binary systems.**
- **Neutron Stars [Ch. 23]**
  - **Properties. Reason for rapid rotation. Evolution. Binary pulsars and their importance. Novae and bursters.**
- **Black Holes [Ch. 24]**
  - **Schwarzschild radius. Special relativity. General Theory of Relativity. Structure of a Black Hole. Existence of Black Holes, Gravitational lensing.**

Section C: (Chapters 25-29):

- **Our Galaxy [Ch. 25]**
  - **Structural features (size, shape, components). Stellar clusters (properties and types). Location of Sun. Interstellar medium . Interstellar obscuration. Nebulae (reflection, dark, emission). Origin of Milky Way. Rotation. Measuring the Milky Way's mass. Galactic center -- possible scenarios and why important.**
- **Galaxies [Ch. 26]**
  - **Types of galaxies and their properties. Measuring galaxy distances. Standard candles. Hubble law and its use. Local group and Clusters of galaxies. Dark matter -- evidence for its existence. Galactic evolution.**
- **Quasers and Active Galaxies [Ch. 27]**
  - **Quasars, Seyfert and Radio galaxies. Discovery, properties, and models. Massive black holes.**

- **Cosmology: The Creation and Fate of the Universe [Ch 28]**
  - **Evidence for expanding Universe. Cosmological principle. Olber's paradox. Microwave background -- its origin. Cosmological models (Steady State, Big Bang). Geometry of Universe. Dark matter.**

- **Exploring the Early Universe [Ch 29]**
  - **Properties of early Universe. The flatness and isotropy problem. Inflation. Galaxy formation. Unification of the fundamental forces. Cosmic strings and other oddities.**

The above is a guide only: