

Astron 300: Astronomy I

Fall 2010, David Kaplan

Syllabus

Lectures: MWF 10:00am-10:50am, Physics 232

- Attendance and participation at lectures is required.
- I will be absent for a small number of classes. Alternate lecturers will fill in.

Lecturer: Prof. David Kaplan

- Office: Physics 480
- Office hours: Monday 11am or by appointment
- Email: kaplan@uwm.edu
- Phone: 414-229-4971

Course Description: This is a general course intended to introduce quantitative astronomy and astrophysics to students with a physical-sciences background. A background in calculus-based physics is required. This semester introduces basic concepts in astronomy and astrophysics including:

- Astronomical coordinates
- Celestial mechanics
- The nature of light and its interaction with matter
- The structure and evolution of single stars
- The evolution of binary stars
- The end-products of stellar evolution

The following semester (Astron 320) will extend this discussion beyond the Milky Way.

Course Website: http://www.lsc-group.uwm.edu/~kaplan/astron300_fall2010.html

Lecture notes, reading assignments, and problem sets will be posted there.

Course Textbook:

An Introduction to Modern Astrophysics, 2nd edition, by B. W. Carroll & D. A. Ostlie (Addison-Wesley, 2006)

Evaluation:

- Problem sets (weekly): 50%; grade will be best 10 of 11 problem sets
- Midterm exam: 20%
- Final exam: 30%

You are encouraged to discuss the problem sets with each other but are not allowed to copy each other. The mid-term will be an in-class, open-book exam of 1 hour duration and the final exam (Thur, 12/16, 10am-noon) will be a closed-book exam of 2 hours duration (only calculator allowed).

Prerequisites: basic physics & calculus (Physics 210) or by discussion.

Detailed Syllabus:

(this mostly follows C&O, but skips around)

Topic	Contents
Course overview	Syllabus; basic astronomical units; celestial sphere; seasons C&O 1
Distances	Distances to Sun, Moon, nearby stars; parallax; magnitudes C&O 3.1, 3.2
Gravity I	Kepler's laws (for 1-body); energy & angular momentum C&O 2.1, 2.2
Gravity II	Generalized Kepler's laws for 2-body (binary stars); N-body. C&O 2.3
Gravity III	Tides; tidal friction; synchronization & circularization C&O 19.2, 18.1 (up to "classes of binary stars")
Gravity IV	Detecting extra-solar planets C&O 7.4
Astrophysics I: Hydrostatic Equilibrium	Gravity of spherical body; dynamical collapse; hydrostatic equilibrium; pressure; ideal gas; mean molecular weight. C&O 10.1, 10.2
Astrophysics II: Virial Theorem	Gravitational, thermal, kinetic energy; virial theorem; application to Sun; gravito-thermal collapse, negative specific heat. C&O 2.4, 10.3
Astrophysics III: Nuclear Fusion	Binding energy of nucleus; quantum tunneling; nuclear fusion; stability of the Sun C&O 5.4 (up to p. 132), 10.3
Astrophysics IV: Radiation	Photons; mean free path, random walk, photon diffusion time; blackbody; photosphere of the Sun. C&O 3.3, 3.4, 5.2, 9.3
Astrophysics V: Photon-Matter Interaction	Hydrogen model atom; electronic transitions; stellar spectra; optical depth, radiative transfer equation. C&O 3.5, 5, 8.1 (parts), 10.4 (up to pressure scale height)
Stars I: Main Sequence	Basic equations of stellar structure; mass-radius-luminosity relation; life times of stars on main-sequence; color-magnitude diagram; spectral types, UBV photometry. C&O 10.5 (up to numerical model), 10.6, 7, 3.6, 8.2
Stars II: Post Main Sequence	Evolution of low mass stars after core-hydrogen exhaustion. C&O 13.1, 13.2
Stars III: Post Main Sequence (cont'd)	Evolution of high mass stars after core-hydrogen exhaustion. C&O 15.1, 15.2, 16.3

Topic	Contents
Stars IV: Summary	Summary of the lives of stars; using clusters to check our understanding C&O 13.3
Stellar Corpses	End products of stellar evolution; white dwarfs, neutron stars, and black holes; degeneracy; ultra-dense matter. C&O 16.1-16.4, 16.6, 16.7, 17 (only basics)
Explosions	Supernovae & supernova remnants
Star Formation	Jeans mass, observations, disk formation, binary formation. C&O 12
Telescopes	Diffraction limit; seeing and atmospheric turbulence; radio telescopes and interferometry; X-ray & gamma-ray telescopes. C&O 6
Special Topic	Students will choose from one of a number of topics related to current research

Special Items:

Wed, Sep 8 will be a special planetarium program. Meet outside (across from Physics 137) at 10:00am, or a few minutes early. If you come late, you will be locked out!