Astronomy 0113

Introduction to Astronomy

Stars, Galaxies, and the Cosmos

Class meets:

MWF: 3.00 to 3.50pm
Thaw 102

Instructor:

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Office Hours:

Mondays 11.00 - 12.00 pm
Friday 10.00 - 11.00 am
(or by appointment)

Text Book:

UNIVERSE (4th Edition)

by W. J. Kaufmann III (W. H. Freeman and Company)

[Compulsory]

Other Useful textbooks (1 Copy, Physics Library Reserve)

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

Self-contained course for students majoring in the physical sciences. Course has a high descriptive content with extensive use of math and geometry. Minimal calculus is required.

Major topics:

Fundamentals of Astronomy, Stars, Galaxies, Cosmolog**y**

Non-Science and Engineering Majors:

Instead of taking ASTRONOMY 0113, those students without a science background (or who are allergic to math) may be better served by taking ASTRONOMY 089**.** This course is similar to 113 but is much more descriptive, and involves less math. A disadvantage with A0089 is the larger class sizes.

Assigned Reading:

A: Introduction, Chapters 1 -- 7, (Exam 1, Final Exam)

B: Chapters 18 -- 24 (Exam 2, Final Exam)

C: Chapters 25 --29 , Essay 5 (Final Exam)

NB:

1. Chapters 8-17 (which deal with the solar system in detail) will not be covered in the course (or examined).

2. The final exam will cover the entire course. More emphasis (eg 50%) will, however, be given to chapters 25-29.

Study Technique:

Read Chapter BEFORE lesson.

SIMPLE note taking in class.

At the end of each chapter a list of key words and ideas are presented. Use these to determine whether you have understood the chapter's/lectures contents.

Review chapter at end of class: Revise Notes.

Do the review and advanced questions at the end of each chapter. Exam questions will, in part, be based on these.

It is important that you keep up. Concepts introduced early in the book will be used later.

Materials

Paper, pen, pencil, and eraser required

Graph paper, ruler, compass, and calculator will also be required at various times.

Exam Policy

Students **MUST** bring their ID cards to exams.

Three exams will be given, and 75% of the course grade will be based on these exams. All exams are compulsory. If an exam can't be taken I (or the department) must be notified **PRIOR** to the exam. If the excuse is valid (which must be given to the instructor in writing) the exam will be given, if feasible, on an alternative day. In **EXCEPTIONAL** circumstances an essay (> 20 typed pages, double spacing) , on a topic of the instructors choice, will be assigned. The essay grade WILL NOT significantly boost your average grade.

The first 2 exams, each covering approximately 1/3 of the course, will not be cumulative. The final exam is cumulative.

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.

Homework:

Regular homework assignments will be given. These must be completed on time. For every day late, 14% of the total grade will be deducted. Assignments more than 1 week late will not be accepted.

NB: The homework is to be regarded as a learning experience. If you can't do a problem do not copy some else's work. **Instead contact the instructor and arrange a time when the problem can be discussed.** No marks will be deducted for discussing the problem with the instructor.

Since the exams will have similar problems to the homework, it is important that **you understand the problems** and not just the answer.

Marks will be deducted for untidy or careless work.

CLEA computer exercises will also be assigned as homework.

Grading Summary:

Exam 1:	20%
Exam 2.	20%
Final Exam :	35%
Homework:	25%

The homework mark is critical to determining your final grade.

IMPORTANT DATES

Holidays

Monday Sep 1 -- Labor day

Nov 26-Nov 30 (Wed-Sun) -- Thanksgiving holiday

Class tests (1 hr):

Monday Oct 6 -- Section A (Chapters 1 to 7)

Friday Nov 7 -- Section B (Chapters 18 to 24)

Final Cumulative Exam (2 hrs):

Tuesday December 9th (12:00 -- 1:50)

(Chapters 1-7, 18-29)

All material covered in class is examinable, unless specifically stated otherwise**.**

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

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 Ancient Astronomy [Ch 3.]

Phases of the moon. Eclipses. Lunar and Solar eclipses. Sidereal and Synodic months.

Gravity and the 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 Stars - 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.

Stellar Maturity and Old Age [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. Stellar pulsations.

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, including s and r processes. 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 -- The Milky Way [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: