Astronomy 121– Introduction to Astronomy
Summer 2005 – EDP Session VI

Syllabus

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My educational philosophy is that you learn best when you are actively engaged with the subject through activities such as reading (and answering questions about what you read), discussing, experimenting, and solving problems. Lectures are useful for motivation, but for most students listening to lectures and copying lecture notes is an ineffective method to learn. It's when you study individually (or sometimes in a small group), think deeply about the subject, and subsequently dialogue with classmates and the professor that you learn the most. My role as the professor is to create an environment that promotes active-learning, to assess your learning, and to provide guidance and mentorship along the way. One does not receive knowledge, one builds knowledge.

Lecture and Lab: MTTh 6:00 pm–9:30 pm, 325 HHSC

Office and/or Lab Hours: I'm here at the office most of the time. You can email me or call me. You can also meet with me before or after class.

Course Description: An introduction to astronomy covering the motions, distances, and physical nature of heavenly bodies. Topics include the history of astronomy, the scientific method, and current views of cosmology.

Textbook(s) and other materials: Our textbook is *The Cosmos: Astronomy in the New Millenium*, by Pasachoff and Filippenko. It is required for the course, since you will read it and use it to answer homework questions. For a popular introduction to amateur astronomy, I recommend *Nightwatch* by Terence Dickinson [2]. We will also use selected tutorials from *Lecture Tutorials for Introductory Astronomy* by Jeffrey Adams, Edward Prather, and Timothy Slater [1].

In addition, you will need a scientific calculator.

Course web site: <http://linus.highpoint.edu/~atitus/courses/ast121/>

Grading Scale (min%): A+ (96), A (92), A− (88), B+ (84), B (80), B− (76), C+ (72), C (68), C− (64), D+ (60), D (56), D− (52), F (<52).

Grade Determination: experiments and in-class activities (25%), homework (20%), quizzes (15%), mid-term exam (20%), final exam (20%). There will be approximately one quiz per week. The mid-term exam and final exam will be cumulative and will also cover topics studied in the laboratory.

Attendance: Because you will work in groups, it is essential for everyone to attend class. If you miss 3 classes, you will be given a probation notice. If you miss 4 classes, you will be withdrawn from the course. Classwork and lab work should be made up, though labs that require significant set up cannot be made up. Quizzes cannot be made up. If you get a zero on a quiz or lab and you have an excused absence, then I will substitute your average exam score for the lab or quiz that you missed.

WebAssign: Homework, quizzes, and exams will be delivered, collected, and graded using WebAssign. To get to WebAssign, you should first log in to Blackboard at the address shown below, select the link to this class, and then click on the link to WebAssign.

<http://blackboard.highpoint.edu/>

Homework assignments cover material that you should read in the textbook before the material is covered in class. There is approximately one homework assignment for each class day. They will be posted approximately one week in advance.

Lab: In addition to our in-class lab activities, we will also take one trip to the planetarium at SciWorks in Winston-Salem and two trips to the Cline Observatory. The observatory trips will be on a Friday night, so in return I will cancel class on the previous Thursday night.

Goal statement for a core course in science for the general education curriculum: Our graduates should understand the methods of and developments in the natural sciences and the impact of science on society and their lives.

Specific objectives of the science course in the general education curriculum:

1. Students should demonstrate that they can use the scientific method of inquiry, including the formulation of a problem, gathering and interpreting data, and deductive reasoning.
2. Students should know the essential principles, theories, and research findings of at least one area of natural science.
3. Students should know how to use scientific apparatus for gathering information and discovery.
4. Students should understand the function of science and its impact in the modern world.

General education requirements for writing: The general education curriculum emphasizes writing in all courses with the exception of mathematics and physical education activity courses. In AST121, students will be graded on their writing. Students must express themselves well and use proper grammar on assignments, examination essay answers, and laboratory reports.

Expectations: Expect to enjoy learning. Astronomy is one of the most exhilarating areas of science. In addition to physics, astronomy touches areas of art, philosophy, religion, archaeology, and history. Expect to be "blown away" by the shear awesomeness of the universe. Expect to ask questions to which nobody knows the answer. Expect to ask yourself questions like "How do I know?" when considering those things you've always been taught. Expect to find a new passion for science.

Accomodations: If you need accomodations due to a disability, please notify Dr. Titus before the end of the first week of class. If you must reschedule the mid-term or final exam due to serious illness, death in the family, participation in official school events, or another such valid reason, please alert Dr. Titus before the event or as soon as possible after the event. Extensions on homework are allowed under these same circumstances, including technical difficulties. You should request a homework extension via WebAssign. Make-up quizzes are not allowed. One missed quiz will be given the same score as your final exam.

Psalms 19

1 The heavens declare the glory of God; the skies proclaim the work of his hands.
2 Day after day they pour forth speech; night after night they display knowledge.
3 There is no speech or language where their voice is not heard.
4 Their voice goes out into all the earth, their words to the ends of the world.

In the heavens he has pitched a tent for the sun,
5 which is like a bridegroom coming forth from his pavilion, like a champion rejoicing to run his course.
6 It rises at one end of the heavens and makes its circuit to the other; nothing is hidden from its heat.

References

[1] Jeffrey P. Adams, Edward E. Prather, and Timothy F. Slater. *Lecture Tutorials for Introductory Astronomy*. Prentice Hall, preliminary edition, 2002.

[2] Terrance Dickinson. *Nightwatch: A Practical Guide to Viewing the Universe*. Firefly Books, 1998.

Learning Objectives:

1. Students will compare the characteristics amongst different types of telescopes.
   (a) know the three functions of a telescope and their relative importance
   (b) compare and contrast a reflector and refractor
   (c) know the important features to consider in buying a telescope
2. Students will know and understand terms that describe the night sky and its motions.
   (a) important terms: constellation, asterism, zodiac, circumpolar star, seasonal star
   (b) know the naming conventions for stars
   (c) understand the nightly and seasonal motions of stars
   (d) identify important seasonal constellations and asterisms on a star map
   (e) locate Polaris on a star map
3. Students will understand stellar magnitudes.
   (a) know how the apparent magnitude scale is defined
   (b) know how distance and luminosity affect apparent magnitude
   (c) know how absolute magnitude is defined
   (d) understand the relationships between apparent magnitude, absolute magnitude and distance
   (e) understand and apply the method of standard candles to estimate distances
4. Students will apply the procedure of trigonometric parallax to measure distance.
   (a) know how apparent motion depends on distance
   (b) understand the difficulties in using this process for measuring stellar distances
   (c) understand how shifts in apparent position are related to distance
   (d) know the definition of a parsec
5. Students will understand how spectra are used to classify stars and to determine their compositions and temperatures.
   (a) understand the concept of electromagnetic (EM) spectra
   (b) understand the relationship between spectral films and brightness versus wavelength graphs
   (c) recognize continuous, emission, and absorption spectra
   (d) understand the physical processes leading to the 3 types of spectra
   (e) know how blackbody spectra are used to find temperature
6. Students will use the H-R diagram to characterize stars.
   (a) understand that stars are classified according to a spectral scheme
   (b) know the relationship between spectral class and temperature
   (c) understand the relationship between luminosity, temperature, and size
   (d) know the parts of an H-R diagram
   (e) understand the scales and axes used on the H-R diagram
   (f) know the names and properties of the major types of stars on the H-R diagram
   (g) understand how the properties of star types are determined
   (h) apply all of the above to describe a star
7. Students will apply the process of spectroscopic parallax for determining relative stellar distances.
   (a) know the steps in the procedure

(b) identify the underlying assumptions and rationale for each step in the procedure

(c) understand the importance of the H-R diagram in extending the distance ladder

8. Students will comprehend the different processes by which stars are born, evolve, and eventually die.

   (a) know how raw materials combine to form stars

   (b) know the basic life cycles of both low and high mass stars

   (c) understand why mass is so important in determining a star's fate

   (d) understand what determines whether the death of a star will result in a black hole, a neutron star, or a white dwarf

   (e) know the state of observational evidence for black holes, neutron stars, and white dwarfs

   (f) understand how a white dwarf can continue to evolve into either a nova or type I supernova and what condition determines this

9. Students will understand the overall structure of our universe.

   (a) know the basic size and structure of our own galaxy and the Sun's place in it

   (b) apply Hubble's classification scheme to identify to which of the four basic types a galaxy belongs

   (c) understand how Cepheid variables were used to extend the distance ladder to galaxies

   (d) know that galaxies are organized into larger structures called clusters and superclusters

   (e) know the two principle galaxies in the local cluster

10. Students will understand the observational evidence supporting the expanding universe hypothesis.

    (a) know how recessional (radial) velocities are determined

    (b) understand the relationship between recessional velocity and distance

    (c) understand how Hubble's constant determines the age of the universe

    (d) understand what makes Hubble's constant difficult to determine

    (e) understand why Quasars are of interest to astronomers.

    (f) know the key observations supporting the Big Bang theory

11. Students will understand how the Greeks were able to learn about the size and shape of the Earth as well as the relative distances to the moon and Sun.

    (a) provide evidence that the Earth is round

    (b) understand the essential features of Eratosthenes' method for determining the size of the Earth

    (c) provide evidence that the Sun is farther away than the Moon

    (d) understand how Aristarchus predicted the relative distances to the Moon and Sun

    (e) apply Aristarchus' method to make predictions of relative Moon-Sun distances

12. Students will understand how Greek cosmological models accounted for available observations.

    (a) know what observational evidence was available to Greek astronomers including the motions of the stars, Sun, and Moon

    (b) know the times and meanings of the equinoxes and solstices

    (c) know how the Sun appears to move relative to the background stars

    (d) understand the meaning of the ecliptic

    (e) know the basic assumptions of the Pythagorean model

    (f) understand how the Pythagorean model accounts for most observations

13. Students will understand how the Ptolemaic model developed as a means for explaining the motions of the planets.

    (a) identify the shortcomings of the Pathagorean model that led to more sophisticated models

(b) know the meaning of epicycles and deferents and how they were used to explain retrograde motion

(c) identify the elements of the full Ptolemaic model that were really violations of the Greek ideals espoused by the Pythagoreans

(d) given a deferent and epicycle, trace Ptolemaic planetary orbits as seen from the North Star

14. Students will understand the major contributions of Copernicus, Tycho, and Kepler.

(a) explain why Copernicus was dissatisfied with the Ptolemaic model

(b) identify the key elements of the Copernican system

(c) identify the elements of the Greek system that were retained in the Copernican system

(d) understand the significance of Tycho's discovery of a supernova and a comet

(e) describe Tycho's major contributions to astronomy

(f) understand how to use Kepler's method to determine Mars' orbit from data listing the bearings to Mars taken at one-Martian-year intervals

(g) understand the meaning of Kepler's three laws of planetary motion

15. Students will understand the implications of Galileo's major observations.

(a) know Galileo's seven important observations

(b) understand how these observations contradicted the Greek ideal of the perfect heavens

(c) understand how these observations were used to support the heliocentric model

16. Students will understand the major contributions of Isaac Newton.

(a) know that objects in orbit are falling towards the center of the Earth

(b) understand the connection between the falling of an apple and the falling of the Moon

(c) understand the relationship between Newton's law of gravity and Kepler's laws of planetary motion

17. Students will understand how theory and observations worked together to identify the remaining planets in the solar system.

(a) know what the Titius-Bode Rule is and how it applies to the solar system

(b) know the details of Herschel's discovery of Uranus

(c) understand how the observed motion of Uranus led to the discovery of Neptune

(d) understand how the discrepancies in the observed motion of Mercury were originally accounted for

(e) know what led astronomers to search for the planet Pluto

(f) know how blinking was used in the discovery of Pluto

18. Students will be able to describe the positions of astronomical objects from both a heliocentric and a geocentric perspective.

(a) know how the observer's position on Earth makes particular objects in the sky visible at specific times

(b) analyze the rotation of an Earth observer to predict the rising and setting times of sky objects

(c) interpret heliocentric positions in terms of a geocentric model and vice versa

19. Students will know the basic physical and dynamical properties of the planets.

(a) know the common features of the motions of the planets and moons

(b) distinguish between the terrestrial and Jovian planets

(c) know how the current model of planetary formation accounts for these properties

20. Student will know the properties of meteors, asteroids, and comets.

(a) identify the cause of meteors

(b) know the cause of meteor showers

(c) understand the best time for observing a meteor shower

(d) know where most asteroids reside

(e) know what distinguishes an Apollo asteroid

(f) know how asteroids are believed to affect life on Earth

(g) know the basic structure of comets

(h) understand what produces a comet's tail

(i) know the sources of short and long period comets

21. Students will have some basic knowledge of our star: the Sun.

    (a) know the approximate size, temperature, and composition of the Sun

    (b) know what sunspots are and how the solar cycle operates

    (c) know how, besides being the source of light and heat, the Sun affects life on Earth

22. Students will develop a mental model of the Sun-Earth-Moon geometry that both explains and predicts lunar phases.

    (a) know the terminology associated with the Moon phases

    (b) predict the phase of the Moon given the relative positions of the Sun-Earth-Moon system

    (c) predict the relative positions of the Sun-Earth-Moon system given the Moon phase and time of day

This schedule is tentative. We will cover all of this material, but dates may change. Observation and planetarium dates will depend on other factors such as the weather and the planetarium schedule at SciWorks.

Schedule					
date	**class**	**topics**	**reading**	**activity**	**lab**
T, 6/14/05	1	Introduction	1	worksheets	checkerboard universe
Th, 6/16/05	2	Light, Matter, and Energy	2	worksheets	emission spectra
M, 6/20/05	3	Light and Telescopes	3		telescope
T, 6/21/05	4	Observing the stars and planets	4	worksheets	Constellations, celestial globe and coordinates
Th, 6/23/05	5	Newton's laws of motion	5	simulations	Newton's second law
M, 6/27/05	6	Gravity	5	Mechanical Universe – Kepler	CLEA: Moons of Jupiter
T, 6/28/05	7	The terrestrial planets	6	*Nova: Venus Unveiled*	CLEA: Rotation Rate of Mercury
Th, 6/30/05	8	The Jovian planets	7	*Jupiter, Saturn, & Uranus: The Voyager Missions and "I will see such things"*	Retrograde motion
M, 7/4/05 Independence Day, no class					
T, 7/5/05	9	Pluto, comets, and space debris	8	*Nova: The Doomsday Asteroid*	CLEA: Astrometry of Asteroids
Th, 7/7/05	10	Our solar system and others	9	review	Finish CLEA lab
M, 7/11/05 Midterm Exam					
T, 7/12/05	11	The Sun, Stars	10-11	*Nova: The Eclipse of the Century*	H-R diagrams
Th, 7/14/05	12	Binaries and clusters	11		CLEA: Stellar classification
M, 7/18/05	13	How stars shine, The death of stars	12–13	*Nova: The Death of a Star*	
T, 7/19/05	14	Black holes	14	*Stephen Hawking's Universe: Black Holes and Beyond*	CLEA: Radio Astronomy of Pulsars
Th, 7/21/05	15	Finish CLEA lab			Observing
M, 7/25/05	16	The Milky Way and galaxies	15–16	expanding rubber band	CLEA: The Hubble Redshift Distance Relation
T, 7/26/05 Observing (depends on a lot of factors)					
Th, 7/28/05	18	Quasars and active galaxies	17	Stephen Hawking's Universe	
M, 8/1/05	19	Cosmology	18	*The Creation of the Universe*	
T, 8/2/05: No Class					
Final Exam: 8/4/05					

Introduction to Astronomy. by Dr. Karina KjÃ¦r. Ratings: (13).Â Dr. KjÃ¦r is a Danish national, who has been passionate about science since childhood. In 2001 she obtained a Bachelor degree in Science and in 2003 a Master degree in Astronomy from the University of Copenhagen. During these studies she worked as a research assistant and participated in observing runs More about Dr. Karina KjÃ¦r. Get ahead at work with our collection of personal development eBooks. Download 1,700+ eBooks on soft skills and professional efficiency, from communicating effectively over Excel and Outlook, to project management and how to deal with difficult people. Written by in Astronomy has taught During the rapid development of seafaring, when us the real scale of the nature surrounding us. voyages extended farther and farther from home ports, Modern astronomy is fundamental science, moti- position determination presented a problem for which vated mainly by manâ€™s curiosity, his wish to know more astronomy offered a practical solution.Â In the fu- pages of Astronomy and Astrophysics Abstracts, published by the Astronomische Rechen-Institut, Heidelberg. The publica- ture, neutrinos and gravitational waves may also be ob- tion of the series was discontinued in 2000, and for 2005, an served. estimate was made from the Smithsonian/NASA Astrophysics Data System (ADS) Abstract Service in the net.