ASTRONOMY

PHYS 1125 & PHYS1025

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General Information

Course:	Astronomy, 3 credits (2 hours lecture, 2 hours laboratory)
Semester:	Fall 2009
Lecture:	PHYS 1125.51 and
Laboratories:	PHYS 1025.21 or PHYS 1025.51
Syllabus:	http://theflorys.org/David.Flory/Astronomy_Syllabus.php or a PDF file
Prerequisite:	Intermediate algebra and geometry
Corequisite:	The lecture (PHYS 1125.51) requires one section of laboratory (PHYS 1025.21 or PHYS 1025.51) as a corequisite.
Lect times:	Tuesday, 6:00 pm to 7:40 pm in Becton 205
Lab times:	Tuesday, 3:40 pm to 5:20 pm, or Tuesday, 7:50 pm to 9:30 pm, in Becton 202
Instructor:	Prof. David Flory
Office:	Becton Hall, Room 111 (In the basement)
Mail Stop:	T-BEC2-03
Office Hours:	Mon & Wed 1:00-2:00 pm, Tue 2:30-3:30 pm. Other times by appointment.
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Course Description

Observed motions of the sky. Models of the solar system from the Greeks through Newton and Einstein. The composition of matter; the principles of motion, including orbital motion; the nature of light; the principles of optics; and the operation of telescopes and auxiliary instruments. Topics in astronomy include stellar astronomy, celestial coordinates; types of stars including white dwarfs, red giants, super-novas, pulsars, neutron stars, and black holes; galaxies, the universe, and cosmology. The presentation is descriptive not quantitative. Experiments, observation, some quantitative work, and some analysis are done in the laboratory which is conducted as a hands-on, tutorial experience with personal help always available. Observing sessions will be held, weather permitting.

This course satisfies the general education distribution requirement for a laboratory science for non-science majors. It is also a free elective for anyone seeking an introduction to astronomy.

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Texts and Materials

Main Text:	*Astronomy: The Evolving Universe (9th Edition)*
Author:	Michael Zeilik, Professor of Astronomy and award winning author from the University of New Mexico.
Publisher:	Cambridge University Press (2002). ISBN: 0521800900
Supplement:	Active Learning Astronomy for *Astronomy: The Evolving Universe (9th Edition)*
Author:	Michael Zeilik, Professor of Astronomy, University of New Mexico.
Publisher:	Cambridge University Press (2002). ISBN: 0521529018
Laboratory:	*Physics Laboratory Manual, Astronomy, PHYS 1025*
Authors:	Physics Staff
Publisher:	School of Natural Sciences University College Fairleigh Dickinson University
Supplement:	On-line Guide to Astronomy Lab Reports
Resources:	http://TheFlorys.org/David.Flory/Astronomy_Resources.php
Web Site:	http://TheFlorys.org/David.Flory/Astronomy.php

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Course Requirments

All students are required to obtain an FDU Webmail account. This allows access to FDU's Webcampus and the Blackboard web site for the course. The email facilities of Blackboard will be used to communicate with students and the material on the site is highly recommended. Students who do not wish to use or check their FDU email can set up auto-forwarding to another email address of their choice. Students should also be familiar with the content of the Metropolitan Campus Student Handbook.

Each student in Astronomy must register for a section of laboratory. A passing grade in lab is necessary in order to receive credit for the course. In order to receive a passing grade in lab, all the experiments must be completed and the lab reports handed in.

Attendance in lecture is strongly recommended but not mandatory. Completion of all the experiments in the laboratory is required. This means that a missed laboratory session must be made up. See the Laboratory Guide for details. Students are expected to arrive on time, especially for laboratory. Cell phones and pagers must be turned off in all classes, lab or lecture. For further information, refer to the University Attendance Policy in the Academic Regulations section of the Metropolitan Campus Student Handbook

There will be two formal examinations: a midterm and a final. Each examination will have two sections. The first section will be ten short answer questions on vocabulary and concepts from the text and the lectures. The second section will be a choice of two out of three essays on major topics discussed in class. Numerical work will be done in the laboratory not on the examinations. Sample essay questions and a vocabulary list are available at //theflorys.org/David.Flory/Astronomy.php and on WebCampus. Memorization of numerical information is not required. Understanding of the magnitudes of astronomical quantities will be useful. The vocabulary questions will be graded on accuracy of the definition. The essays will be graded on their quality, clarity, accuracy, and completeness. It is very important to answer the essay questions fully, in detail, and to include all the topics requested. Off topic essays will only receive partial credit based on relevance to the question asked. A missed exam will receive a grade of zero unless made up. A student missing the midterm must be present at the next scheduled class in order to schedule a make-up exam.

We will perform four to six experiments in laboratory. Three of them will require at least three weeks to complete and the others a week each. Each experiment will have a lab report due one week after completion of the experiment. There is an on-line Guide to Astronomy Lab Reports with information on how to write a lab report and what it should contain. A one-week extension on the due date of reports is available upon request. A report more than one week late will have credit deducted. Reports may be rewritten and handed in again. They will be re-graded and the highest grade used. The only condition is that the original report must be submitted along with the re-write. The laboratory grade will be based on the weighted (by weeks required) average report grade and on the general quality of the student's work in the laboratory. Extra effort in lab will result in a better grade.

The course grade will be determined from the average of the grades from the midterm exam, the final exam, and the laboratory. The laboratory and the lecture must *each* be completed in order to receive a grade for

the course. An incomplete laboratory will result in a failing grade unless an incomplete for the course is negotiated prior to the final examination. *The laboratory must be completed in order to pass the course*. Additional work will not be accepted in place of a poor examination grade. However, under appropriate circumstances, a make-up exam may be offered. The University has a formal Grade Appeal Procedure for appealing a course grade.

Fairleigh Dickinson University has an Academic Integrity Policy that each student must read and understand. It can be found in the Academic Regulations section of the Metropolitan Campus Student Handbook on the FDU web site. Students should be aware that material downloaded from the Internet is subject to the same conditions as material copied from any other source. Lab reports must be based on your own data, taken by you in collaboration with your partners. If you did not participate in the taking of the data, use of another's data is plagiarism just as use of another's words is plagiarism

In the laboratory, students will generally work collaboratively in teams of two or three. Each member of a team is expected to participate fully in performing each experiment. Collaboration in understanding and analyzing the results of an experiment is expected. You should always include the names of your lab partners as part of each report. However, laboratory reports, like any other written work, must be original and your own. The raw data you use will be identical to that of your partners; your analysis and the words used to discuss and analyze it must be independent. Each member of a team must write their own lab report.

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Course Objectives

The overall objectives of Astronomy are to present, in a descriptive format, the elements of one of the oldest and most fundamental fields of science and to present some of its exciting recent developments. The student should acquire knowledge about and understanding of the solar system, its motions, and the theories we have developed to explain it; the nature of light; the tools of the astronomer, principally telescopes and spectroscopy; the nature and life cycle of stars; and of cosmology, the description and history of the Universe as a whole. Students will gain a qualitative understanding of how many areas of science come together to explain complex phenomenon like the life of a star or the dynamics of the solar system. They will also see how the interplay of observation, description, classification, model building, theoretical explanation, prediction, and testing form and shape modern science. Specifically, after completion of the course, the student should be able to:

- Present the easily observed motions of the sky including its daily rotation, the monthly phases of the moon, the annual change of seasons and of the constellations visible at night, and the irregular wandering of the planets and to show how these motions were explained by the various models western civilization has created from Greek to modern times.
- Describe the nature of light and the electromagnetic spectrum and to understand the instruments, especially telescopes, used by astronomers to study the heavens.

- Present the properties, classification system, and life cycle of stars including objects like white dwarfs, red giants, super-novas, pulsars, neutron stars, and black holes. To help understand qualitatively some of the physical laws that lead to these phenomena.
- Describe the large scale structure of the Universe including galaxies, active galaxies, quasars, and galactic clusters. Present the evidence for an expanding Universe and describe the various cosmological models including the Big Bang that explain the origin of the Universe, its expansion, and its ultimate ending.
- Discuss the way science progresses from observation and classification of phenomena through model building to the development of comprehensive theories that can explain and predict and that can be tested by experiment.
- Discuss the criteria for a successful scientific theory and apply those criteria to the real world.
- Apply the methods and procedures of science through elementary laboratory exercises and observation. Analyze simple experiments and discuss whether they support or confront a theoretical prediction.

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Teaching Methods

Astronomy is taught as a combination of classroom and laboratory. In the classroom the instructional method is a traditional lecture supplemented with some audio/visual materials. Questions are welcomed. No formal homework will be assigned in lecture. Written work in the form of lab reports will be submitted based on the experiments performed in laboratory. The student is expected to read the text along with the lectures. The lectures will be easier to understand if you read the text first. Students are responsible for the material covered in lecture and for the material in those chapters in the text that are covered by the syllabus. Mastery of the material begins with the text's *Chapter Summary* and *Key Terms.* Use the tools in the text!

In the laboratory the environment is a guided tutorial. Students will be grouped into teams of two or three which work collaboratively to perform the experiments. Each experiment will be introduced by the instructor who will then give individualized help to each team or student. The mathematics used will be individually reviewed, demonstrated, and taught if necessary. Personal assistance is always available. The experiments are a series of exercises that illustrate, reinforce, or complement the material in the text.

Weather permitting, the class will have at least one and perhaps more viewing sessions using our 10" Meade LX200GPS Schmidt-Cassegrain telescope. Viewing sessions will be held after lecture during the late laboratory. Students in the early lab will be expected to attend viewing sessions and will be excused from their regular lab when they attend.

Questions for the instructor about the course and its content are to be asked in class, during office hours, or using the WebCampus/Bb Discussion Board for the section. This will allow all members of the class to benefit form the answers. Email should be reserved tor private questions involving items like individual grades.

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Course Outline

Week 1 Orientation & Chapter 1: From Chaos to Cosmos (Observations of the sky)
Lab: Introduction, pre-test, and view *Powers of Ten*

Week 2 Chapter 2: The Birth of Cosmological Models (Scientific models, Greeks & Ptolemy)
Lab: Coordinate Systems: Terrestrial (CS)

Week 3 Chapter 3: The New Cosmic Order (Copernicus, Brahe, and Kepler)
Lab: Coordinate Systems: Horizon (CS)

Week 4 Chapter 4: The Clockwork Universe (Galileo, Newton, and Gravitation)
Lab: Coordinate Systems: Equatorial (CS)

Week 5 Chapter 5: The Birth of Astrophysics (The nature of light)
Lab: Orbit of Mercury (OM)

Week 6 Chapter 6: Telescopes and Our Insight into the Cosmos & Chapter 7: Einstein's Vision (Telescopes and Einstein) Lab: Orbit of Mercury (OM)

Week 7 Chapter 12: Our Sun: Local Star & Chapter 13 The Stars as Suns (Our Sun, stars and stellar classification) Lab: Orbit of Mercury (OM)

Week 8 Midterm Examination on Chapters 1-7. Detail to be announced. The Midterm Exam may be postponed if we are behind. Lab: Optics: Reflection (O)

Week 9 Chapter 14: Starbirth and Interstellar Matter (Mostly starbirth)
Lab: Optics: Refraction (O)

Week 10 Chapter 15: Star Lives (The life of a star and red giants)
Lab: Optics: Thin Lenses (O)

Week 11 Chapter 16: Stardeath (white dwarfs, supernovas, neutron stars, pulsars, black holes)
Lab: Optics, Thin Lenses & Telescope (O)

Week 12 Chapter 17: The Evolution of the Galaxy & Chapter 18: The Universe of Galaxies (Galaxies, their discovery and their distances) Lab: Spectral Analysis (SA)

Week 13 Chapter 19: Cosmic Violence (Active Galaxies)
Lab: Hertzsprung-Russell Diagram (HRD)

Week 14 Chapter 20: Cosmic History (Cosmology)
Lab: Distance Measurements
Notice and Warning! If we are significantly behind the syllabus, lecture may continue through the late lab for this final week of class. If this occurs, the early lab will be cancelled.

Week 15 Final Examination on Chapters 13-20. Detail to be announced. No laboratory during finals week.

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Viewing Assignments

Watch the moon. Try to stay aware of the phases of the moon for the entire semester. When is it full, new, waxing (getting bigger), or waning (getting smaller)? Where is it in the sky and at what time for each of its phases? Where is the sun for each of the moon's phases? How much does it change from week to week?

Find and observe the constellation Orion. When does it become visible? At what time and in what month? At midnight is it in the same place in the sky at the end of the semester as it was at the beginning? Are its stars all the same color? Learn to identify Betelgeuse and Rigel, its two brightest stars.

Find and observe the Big Dipper (Ursa Major). Learn to use the pointer stars to locate the North Star (Polaris). Learn to use the handle to locate Arcturus, a red giant and the fourth brightest star in the sky. Observe how the orientation of the bowl changes over the semester.

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