ASTRONOMY 340 – FALL 2006

"Origin of the Universe"

I. Instructor

Prof. Eve Ostriker
Office: CSS 1231
Phone: 301-405-1527
email: ostriker@astro.umd.edu
Office hours: Tu Th 12:30-1:30, or by appointment

II. Class Meetings

Tu Th 11:00am-12:15pm
CSS 2400

III. Textbook

Required: *Foundations of Modern Cosmology* (2nd edition), by John F. Hawley and Katherine A. Holcomb. Oxford University Press, ISBN 0-19-853096-X

See also the authors' web page for the texbook at:

`http://www.astro.virginia.edu/~jh8h/Foundations/`

IV. Course Pre-requisites

To take this course, you should have previously completed ASTR100 or ASTR101, and the material we will cover assumes you have a general knowledge of astronomy at that level. In addition, some mathematics (high-school level algebra and geometry) will be required for the classes, homeworks, and examinations.

V. Course Assignments and Grading

Homework	30%
Midterm exam	30%
Final exam	40%

Homework will typically be assigned once a week, due the following week, and must be turned in at the *beginning of class*. Homeworks will be considered late by the end of class and will no longer be accepted. If for some reason you cannot make it to class, you should either ask a friend/classmate to hand in your assignment for you, or make sure that it gets to the instructor beforehand.

If, for whatever reason, the University is officially closed on the due date for an assignment, the due date will be moved to the next lecture.

There will be an in-class midterm exam, and an in-class final exam.

Students who are ill or have another valid excuse must explain the circumstances to the instructor *before* the due date of an assigment or exam, and then complete the work

within the following week, in order to get full credit. Any illnesses or emergencies need to be properly documented.

Points will not be given for any "extra credit projects." It is important to complete all the regular assignments to get the most you can out of the class!

VI. Academic Integrity

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. University standards regarding academic integrity apply to all work performed for credit in this course, and as a student you are responsible for upholding these standards. Particulars of the University's Code are printed in the Undergraduate Catalog, and a description of what constitutes academic dishonesty is also given in the on-line Schedule of Classes. In brief, the Code requires that you must never engage in acts of academic dishonesty at any time. Acts of academic dishonesty include cheating, fabrication, plagiarism, or helping another person to do any of these things. Violation of the Code carries very serious consequences; for more information, please visit http://www.shc.umd.edu.

The rules regarding academic integrity apply to homeworks as well as to exams. As a part of these rules, you must give credit to any book, published article, or web page that you have used to help you with a particular assignment. These rules also apply to unpublished sources of information. In particular, *students are encouraged to discuss assignments and other class material with each other, but every student must personally think through and write up his or her own answers to the homework questions.*

To further exhibit your commitment to academic integrity, remember to sign the Honor Pledge on all examinations and assignments:

> *I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination.*

VII. Course Web Page

The web site for this course can be found at

`http://www.astro.umd.edu/~ostriker/ASTR340`

It will contain links to course information, assignments, and copies of past lecture notes.

VIII. Course Outline (tentative)

A. Pre-History and Early History of Cosmology

Aug. 31 – Introduction *(Ch. 1)*

Sept. 5 – Classical (geocentric) cosmology and astronomy; Renaissance empiricism and the heliocentric model *(Ch. 2)*

Sept. 7 – Classical (geocentric) cosmology; Renaissance empiricism and the heliocentric model *(Ch. 2)*

Sept. 12 – The Universe of physical law; the age of the Earth and the Cosmos *(Ch. 3)*

Sept. 14 – The Universe of physical law; the age of the Earth and the Cosmos *(Ch. 3)*

B. Relativity

Sept. 19 – Principles of space and time *(Ch. 6)*

Sept. 21 – Special relativity I *(Ch. 7)*

Sept. 26 – Special relativity II*(Ch. 7)*

Sept. 28 – Special relativity III; the need for General Relativity *(Ch. 7, 8)*

Oct. 3 – General relativity I *(Ch. 8)*

Oct. 5 – General relativity II *(Ch. 8)*

Oct. 10 – Black holes *(Ch. 9)*

C. Modern Cosmology

Oct. 12 – The Universe beyond our Galaxy; cosmological expansion *(Ch. 10)*

Oct. 17 – The Universe beyond our Galaxy; cosmological expansion *(Ch. 10)*

Oct. 19 – Geometry and evolution of the Universe *(Ch. 11)*

Oct. 24 – Geometry and evolution of the Universe *(Ch. 11)*

Oct. 26 – MIDTERM EXAM *(covers through Ch. 10)*

Oct. 31 – The Big Bang and early Universe *(Ch. 12)*

Nov. 2 – The Big Bang and early Universe *(Ch. 12)*

Nov. 7 – The Big Bang and early Universe *(Ch. 12)*

D. Contemporary Cosmology

Nov. 9 – Measurement of cosmological parameters *(Ch. 13)*

Nov. 14 – Measurement of cosmological parameters *(Ch. 13)*

Nov. 16 – Cosmic background radiation *(Ch. 14)*

Nov. 21 – Cosmic background radiation *(Ch. 14)*

Nov. 23 – *NO CLASS: THANKSGIVING HOLIDAY*

Nov. 28 – Dark matter and cosmic structure formation *(Ch. 15)*

Nov. 30 – Dark matter and cosmic structure formation *(Ch. 15)*

Dec. 5 – Cosmological inflation *(Ch. 16)*

Dec. 7 – Cosmological inflation *(Ch. 16)*

Dec. 12 – Last Class/Review for Final Exam

Dec. 14 – *Final Exam (8:00-10:00 am)*

IX. Course Description

Throughout history, curiosity has driven humankind to explore our world, always reaching past the known to discover what lies beyond. Over the years, technological advances have opened ever-farther horizons, and more and more of the Universe has come within the compass of human knowledge. By careful observational study, scientists have developed a remarkably detailed empirical understanding of the physical structure and evolution of the Cosmos from its beginnings up to the present. At the same time, the human drive to make sense of what we in perceive in the world has led to the development of scientific theories. In cosmology as in other branches of physical science, the goal of theory is to develop mathematical models that interpret and explain existing empirical data, and to make predictions that may falsify or test the limits of a proposed model. Contemporary cosmological theory has been able to explain many of the amazing aspects of the Universe around us – including why the most distant astronomical objects recede at nearly the speed of light, why we live among planets, stars, and galaxies rather than a uniform "soup" of diffuse matter, and why the Cosmos everywhere is filled with pervasive low-energy background radiation. However, many mysteries – such as the nature of the "dark matter" and "dark energy" that vastly outweigh normal visible matter – remain unsolved.

In this course, we will cover the development of scientific study of the Universe from its early beginnings up to the successes and challenges of forefront research taking place today. Along the way, we will explore the theories of relativity that Einstein first introduced 100 years ago, revolutionizing our conception of space and time, and underpinning the modern theory of cosmology as we now know it.