# AST 396C/PHY394T Syllabus
# Fall 2014

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| **Course Title:** | "Elements of Cosmology" | |
| **Course Number:** | AST 396C | (Unique No. 48680) |
| | PHY 394T | (Unique No. 58375) |
| **Hours:** | Tu, Th | 11:00 - 12:30 p.m. |
| **Location:** | RLM 5.104 | |
| **Textbooks:** | Weinberg, S. 2008 *Cosmology* (Oxford University Press) | |
| **Exams:** | None | |
| **Homework:** | (1) Problem sets will be assigned.<br>(2) One end-of-semester student lecture on a topic selected in consultation with the professor, with lecture notes handed in. | |
| **Grading:** | Course grade will be based upon the problem sets and student talk/lecture notes. | |
| **Instructor:** | Professor Paul R. Shapiro | |
| | Office: | RLM 16.204 |
| | Phone: | 471-9422 |
| | Email: | shapiro@astro.as.utexas.edu |
| | Office Hours: | after class or by appointment |
| **Prerequisites:** | Suitable for all beginning or advanced graduate students in astronomy or physics. Previous course in cosmology not required. | |

Professor Paul R. Shapiro Fall 2014

# AST 396C/PHY 394T
# Elements of Cosmology

## OUTLINE

Part I. The Background Universe: A Summary of Standard, Homogeneous Big Bang Cosmology

1. Newtonian Cosmology and the Friedmann Models

    1.1 Newtonian Fluid Equations and Poisson's Equation

    1.2 The Cosmological Principle: Homogeneity and Isotropy

    1.3 Universal Expansion

        1.3.1 Scale Factor and Hubble Constant
        1.3.2 Hubble Expansion Law

    1.4 Dynamics of Hubble Expansion and the Matter Content of the Universe

        1.4.1 Evolution of $H(t)$
        1.4.2 Density Parameter: $\Omega$
        1.4.3 Deceleration Parameter: $q$
        1.4.4 Matter-Dominated Models: Open, Closed, and Einstein-de Sitter
        1.4.5 The Effect of a Cosmological Constant

2. Relativistic Cosmology: the Friedmann-Robertson-Walker Universe

    2.1 Robertson-Walker Metric

    2.2 Redshift

    2.3 Distance and Angles in a FRW Universe

        2.3.1 Luminosity Distance
        2.3.2 Angular Diameter Distance

    2.4 Number Counts

    2.5 Friedmann Equations and the Friedman Models

    2.6 Age of the Universe

        2.6.1 Hubble Expansion Age
        2.6.2 Direct Age Estimates

3. Thermal History of the Universe: The Big Bang

    3.1 Radiation- vs. Matter-Dominated Epochs

    3.2 Overview of Thermal History

    3.3 Microscopic Distribution Functions and Equilibrium Thermodynamics in the Early Universe

    3.4 Coupled vs. Decoupled Species

    3.5 Big Bang Nucleosynthesis