Astronomy 405

Astro 508, Cosmology

2-3 hrs/week, lectures begin on Jan 5, 2015.

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Intro undergraduate level text: Barbara Ryden, Introduction to Cosmology
More advanced (graduate level) books on Cosmology by the following authors:
S. Dodelson, V. Mukhanov, S. Weinberg, J. Peacock ....

Grades

The course grade will be determined from various components of the course in the following way:
(a) Two exams (based on homework and practice problems) count for 50 %.
(b) Two projects will count for 50 %.

Tentative Schedule

Part 1. Introduction

Short summary of the current state of understanding of cosmology.
Distance, time and energy scales involved
Review of (or semi-technical introduction to) relevant physics: standard model of particles and fields + gravity. Relativistic theory and relativistic notations.

Part 2. Evolution of the homogeneous Universe

Freidmann's Equations and their solutions. Kinematics of the expansion and contraction
Sources of energy density: radiation, matter and the cosmological constant. "Quintessence"
Redshift, horizons, luminosity distance
FRW Universe, and the current energy balance

Part 3. Benchmarks of the hot Big Bang

Baryogenesis
Big Bang Nucleosynthesis
Possible origin of dark matter
Physics of recombination and decoupling of the CMB

Part 4. Inhomogeneous Universe

Harrison-Zeldovich power spectrum
Possible origin of power spectrum: inflation
Generation of the CMB anisotropies. CMB polarization. Signatures of scalar and tensor perturbations
Growth of cosmological structure. Linear and non-linear regimes. First stars, reionization
Dark matter haloes

Part 5. Open questions in cosmology + observational aspects

Student projects