The Course Outline: Cosmology, Fall 1391 (Fall 2012)

Cosmology is the science of the universe as a whole. A study of cosmology brings smallest scales, relevant to quantum mechanics and particle physics, in contact with the largest scales, scales as big as the size of the universe. Many progresses on the theoretical sides as well as numerous ground-based and space-based observations during past two decades made cosmology a very active area of research. In some senses, we are at the golden age of cosmology.

This course is devoted to theoretical cosmology at the PhD level. There are numerous textbooks on this subject, many of them written by leading researchers of this field. In this course we will mainly follow the excellent textbook by Steven Weinberg: **"Cosmology"**, Oxford University Press, 2008. This is an excellent textbook written by a leading theoretical physicist. Many theoretical and observational aspects of modern cosmology are treated extensively and carefully, as is typical of Weinberg.

We will also frequently use the excellent monograph by Kolb and Turner, **"The Early Universe"**, Addison Wesley, 1994. This is an excellent book written by two leading cosmologists, specially the first few chapters are very useful. Only that this book is old and recent developments, specially on the observational sides, are missing in this book.

Alternatively, the students may find the book by Dodelson: **"Modern Cosmology"** specially in dealing with CMB physics very helpful. Those students who are interested in cosmological perturbation theory and its applications to inflation may also find the book by Mukhanov: **"Physical Foundations of Cosmology"** useful.

The course has two main parts. Part 1: the homogeneous universe and part 2: the inhomogeneous universe. In the first part, we study the standard homogenous and isotropic FRW cosmology, the thermal history of the universe, big bang nucleosynthesis and the shortcomings associated with the big bang cosmology. During this course of study, we shall encounter numerous observational facts related to cosmological parameters such as dark matter, dark energy, the age of the universe etc. During the first part of the course, we will follow Weinberg, selected topics from chapters 1-4 as well as first few chapters of Kolb-Turner.

In the the second part of the course we systematically study cosmological perturbation theory with the aim to apply these tools to inflationary universe. Some models of inflation will be studied and the observational predictions of inflation on CMB will be reviewed. We will schematically use chapters 5, 6 and 10 of Weinberg for the second part of the course. Alternatively, students may find chapters 6-8 of Mukhanov helpful for the inhomogeneous universe.

During the semester several problems sets will be presented. All students are strongly advised to work out the exercises carefully. Working these exercises are essential for a proper and practical understanding of cosmology.

Mr. Mohammad Hossein Namjoo is the teaching assistant for this course and shall arrange for several tutorial classes during the semester. His contact information is

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Time and place of the course: Tuesday and Wednesday, 8:30-10:30 am, IPM, School of Astronomy, Larak garden.

My Contact information

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