BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI- HYDERABAD CAMPUS
SECOND SEMESTER 2018-2019
COURSE HANDOUT (PART-II)

7-1-2019

In addition to part I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : **MATH F456**
Course Title : **Cosmology**
Instructor-in-charge : **Rahul Nigam**

1. **Scope and Objective of the Course:**

This course will serve as an introduction to Cosmology, which is a fascinating branch of science and deals with large scale structure of the Universe as a whole, in particular the origin, evolution and ultimate fate of the Universe. In this course, we shall introduce the fundamentals of modern cosmology via the Mathematics of Newtonian Mechanics starting with the observational overview of the Universe. With the derivation of necessary equations governing the evolution of Universe, we will motivate and analyse the basic mathematical models of the Universe. The remainder of the course will be devoted to explain and understand the observed features of the Universe by extending the basic mathematical models, where we will discuss topics such as cosmic acceleration, cosmological constant, cosmic microwave background, inflation and nucleosynthesis in early Universe.

2. **Text Book:** A. Liddle: An Introduction to Modern Cosmology, Relativity and Cosmology, 2rd edition,Wiley (2003).

3. **Reference Books**:

R1. S. Weinberg, Gravitation and Cosmology, John Wiley, New York, (1972).

R2. M. Rowan-Robinson, Cosmology, 3rd edition, Oxford University Press (1996).

R3: J. A. Peacock: Cosmological Physics, Cambridge University Press (1999).

4.Course Plan: (Sections/Articles refer to Text Book)

Lect No.	Learning Objectives	Topics to be covered	Chapter in the Text Book
1	Introduction	Brief history of cosmological ideas	Chapter 1
2-5	Observational overview of the Universe	In visible light, In other wavebands, Homogeneity and isotropy, The expansion of the Universe, Particles in the Universe	2.1-2.5
6-8	Newtonian Gravity and basic equations of the Universe	The Friedman equation, Meaning of the expansion, Things that go faster than light, The fluid equation, The acceleration equation, Mass, energy and vanishing factors of c2	3.1-3.6
9,10	The geometry of the Universe	Flat, Spherical and Hyperbolic geometries, Infinite and observable Universes, Place of Big Bang, Three values of k	4.1-4.6
11-13	Simple cosmological models	Hubble's law, Expansion and redshift, Matter, Radiation, Mixtures, Particle number densities, Evolution including Curvature	5.1-5.5
14,15	Observational parameters	Hubble parameter, Density parameter, Deceleration parameter	6.1-6.3

16,17	Cosmological constant and age of the Universe	Cosmological constant, Fluid description, Cosmological models with cosmological constant, Age of the Universe	7.1-7.3 Chapter 8
18-21	Density of Universe and dark matter	Weighing the Universe through counting stars, nucleosynthesis, galaxy rotation curves, galaxy cluster composition, bulk motions, formation of structure, brightness of supernovae, Nature of dark matter and its searches	9.1-9.3
22-24	Cosmic microwave background	Properties of the microwave background, photon to baryon ratio, origin of microwave background	10.1-10.4
25-27	Early Universe and nucleosynthesis	The early Universe, Hydrogen and Helium, Comparing with observations, Contrasting decoupling and nucleosynthesis	Chapter 11 12.1-12.3
28-32	Inflationary Universe	Problems with Hot Big Bang: Flatness, horizon and relic particle abundances, Inflationary expansion, Solution of Big Bang problems, Extent of inflation, Inflation and particle physics	13.1-13.5
33, 34	Initial singularity and the overview of standard cosmological model	The initial singularity, Overview of the standard cosmological model	Chapter 14 Chapter 15
35-38	Advanced topics	General relativistic cosmology, Distances and luminosities, Structures in the Universe	Advanced topics 1-2,5

5.Evaluation Scheme :

Evaluation Component	Duration	Weightage	Date & Time	Nature of Component
Mid-Sem	1.5Hr.	30%	11/3 9.00 - 10.30AM	Close Book
Assignment/ Presentation		30%		
Compre. Exam	3Hr.	40%	01/05 FN	Close Book

6. Make-up: Make up for the tests will normally be held in the following week. Prior permission must be taken for make-up in advance except extreme medical cases.

7. Chamber consultation hour: To be announced in the class.

8. Notices: All notices related to the course will be put up on the notice board of the Mathematics department/CMS.

9. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge