

PHY654: Cosmology and Galaxy Formation

January – April, 2014

IISER Mohali

General Instructions

1. Welcome to the course. The aim of this course is to familiarise you with modern cosmology and physics of galaxies and galaxy formation.
2. PHY654 is a four credit course. This means that *you are expected to put in up to 8 hours of work each week outside classroom*. Please keep this in mind while managing your time.
3. Kindly note that attending lectures in itself is not sufficient for understanding the subject and you are expected to supplement discussions in class room with independent study and solving problems.
4. Classes for PHY654 are scheduled at 2:00pm on Wednesdays, 12:00noon on Thursdays and 9:00am on Fridays. The session on Fridays is two consecutive slots. All sessions will be held in AB-1B.
5. Problem sets will posted on the course web page.
6. We have a total of 54 scheduled sessions during the semester, of which 5 will be used for tutorials.
7. Each of you will be assigned a term paper problem and you will be expected to make short presentation and also hand over a detailed written report to the instructor for evaluation. These problems will require you to review material in research papers.
8. You will be given problem sets and it is expected that you will work through the problems and discuss these with the instructor in case of any difficulty.
9. **Office Hours:** I am generally available in my office between 12:00noon-1:00pm on Mon.-Fri. If you are planning to see me some day then sending a one line e-mail in the morning will help as I will avoid drifting off for other work at this time, or warn you in case I have a prior appointment on that particular day.
10. You are strongly encouraged to use e-mail or office hours for discussions. Other modes (phone, etc.) are to be used only in an emergency.
11. Any notices will be e-mailed to you.
12. The curriculum and recommended books are given on the next page. I will provide references to review articles, lecture notes and research papers whenever we start on a new topic.
13. I will appreciate it if you point out any mistakes in notes, problems or class room discussion as it helps to improve the quality of course.

Evaluation Scheme

Component	Total Number	Duration	Individual Weightage	Total Weightage
Mid-Semester Exams	2	1 hour	15%	30%
Term Paper	1		15%	15%
Tutorials	5	1 hour	3%	15%
End Semester Exam	1	3 hours	40%	40%

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[Cr: 4, Lc: 3, Tt: 1, Lb: 1]

- Galaxies, types of galaxies, morphological distribution, large scale distribution of galaxies, clustering of galaxies, large scale homogeneity and isotropy. A cosmic inventory.
- Hubble's law, expansion of the universe, comoving coordinates.
- Cosmological principle, Friedman-Robertson-Walker-Lemaitre model, Cosmological models. Distance redshift relation. Luminosity distance and angular diameter distance. Measurement of Hubble's constant, age of the universe, distance measurements and estimation of cosmological parameters. Accelerated expansion.
- Newtonian limit, non-relativistic perturbation theory, growth of perturbations in the linear limit. Nonlinear growth of perturbations. N-Body simulations.
- Dark matter halos, isothermal halos, universal density profiles.
- Theory of mass functions, excursion sets, merger rates for halos.
- Formation of galaxies, feedback from star formation and evolution of galaxies. Super massive black holes and active galactic nuclei. Comparison of models with observations.
- Clusters of galaxies, intra-cluster medium, Sunyaev-Zel'dovich effect.
- History of the universe: the dark ages, formation of first galaxies, reionization, evolution of the inter galactic medium. Revisiting the cosmic inventory.

Recommended Reading

- *Large Scale Structure of the Universe* by P. J. E. Peebles, Princeton Series in Physics, Princeton University Press, 1980.
- *Principles of Physical Cosmology* by P. J. E. Peebles, Princeton Series in Physics, Princeton University Press, 1993.
- *Structure Formation in the Universe* by T. Padmanabhan, Cambridge University Press, 1993.
- *Theoretical Astrophysics, Vol.III: Galaxies and Cosmology* by T. Padmanabhan, Cambridge University Press, 2002.
- *Galaxy Formation* by Malcolm S. Longair, Astronomy and Astrophysics Library, Springer, 2000.
- *Cosmology* by S. Weinberg, Oxford University Press, 2008.
- *Gravitation and Cosmology* by S. Weinberg, Wiley, 1972.
- *Galaxy Formation and Evolution* by Houjun Mo, Frank van den Bosch and Simon White, Cambridge University Press, 2010.
- *Cosmological Physics* by J. A. Peacock, Cambridge Astrophysics, Cambridge University Press, 1998.
- *Galactic Dynamics* by James Binney and Scott Tremaine, Princeton University Press, 1987.
- *Galactic Astronomy* by James Binney and Michael Merrifield, Princeton University Press, 1998.