

Indian Institute of Technology, Kanpur Proposal for a New Course

1. Course No: SPA401
2. Course Title: Galaxies and Observational Cosmology
3. Lectures per week: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional hours: (0-2): 0 (A), Credits ($3*L+2*T+P+A$): 9, Duration of Course: Full Semester
4. Proposing Department: Space Planetary & Astronomical Sciences & Engineering (SPASE)
5. Proposing Instructor: Sharvari Nadkarni-Ghosh, Amitesh Omar and Pankaj Jain
6. Course Description
 - (A) Objectives: The course aims to teach students about basics of galactic and extra galactic astronomy.
 - (B) Contents (preferably in the form of 5 to 10 broad titles):
 1. **Universal Physical Principles in Astrophysical Context** (7 Lectures)
Newtons law of Gravitation, Theory of relativity, Quantum Mechanics, Maxwell Equation, Radiative transfer interaction of light with matter - Absorption, scattering, emission and absorption, Thomson and Compton process, high-energy processes, Synchrotron emission,
 2. **Properties of Galaxies** (12 Lectures)
Observational properties, star-forming regions, Dust, Mass-to-light ratio, supernova remnants, Differential rotation, Stellar dynamics, Virial theorem, Stability, galaxy interactions, radiation from Interstellar Medium (Balmer lines, HI 21 cm-line, Infrared and Radio emission), Magnetic field
 3. **Galaxy clusters** (6 Lectures)
Galaxy clusters - Observations, Observational Properties, Physical processes, Feedbacks, Intergalactic medium - X-ray emission, Thermal & non-thermal radiation, particle interaction with radiation.

4. **Observational Cosmology and extra-galactic astronomy**
(12 Lectures)

Evolution history of the universe and Hubble's law, dark matter and dark energy, distance & angular size measurements, Cosmic distance ladder, Statistical Parameter estimation

5. **Space Missions** (3 lectures): Brief summary of current and future missions - what they will measure and how they will do it.

(C) Pre-requisites:

(D) Short summary for including in the Courses of Study Booklet: Galaxy dynamics and evolution, tidal forces, stellar dynamics, virial theorem, interstellar medium; galaxy clusters, feedback mechanisms in clusters, intergalactic medium, Hubble's law and history of the Universe, cosmological parameters and parameter estimation.

7. Recommended Books:

- The Cosmic Perspective - by Bennet, Donahue, Schneider, Voit.
- Introduction to Astronomy and Astrophysics - Pankaj Jain
- Galaxy Formation and Evolution - Mo, Frank van den Bosch and Wilte
- Galactic Dynamics - Binney and Tremaine
- Principles of Physical Cosmology - Jim Peebles

8. Any other remarks:

Dated: Proposer:

Dated: DUGC/DPGC Convener:

The course is approved/not approved

Chairman, SUGC/SPGC

Dated: