

## **Indian Institute of Technology, Kanpur Proposal for a New Course**

1. Course No: SPA610
2. Course Title: Radio Astronomy I
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 Science & Astronomy
5. Proposing Instructor: Pankaj Jain
6. Course Description
  - (A) Objectives: The course aims to introduce students to fundamentals of radio astronomy. It will introduce the sources of radio waves in the Universe. It will also discuss the radio telescopes and the data analysis techniques. It will be offered as a compulsory course for M. Tech. students choosing Radio Astronomy as their specialization.
  - (B) Contents (preferably in the form of 5 to 10 broad titles):

S. no.	Broad Title	Topics	No. of lectures
1.	Introduction	Distances & Measurement systems, Astronomical observations, Astronomical coordinate systems, Astrometry	6
2.	Stars and galaxies	A brief overview of Stellar Structure and Evolution, Milky Way and Interstellar Medium, Extragalactic Astronomy	6
3.	Basic theory concepts	Radiative Transfer, Radiation from moving charges, Special Relativity, Bremsstrahlung, Synchrotron Radiation, Compton Scattering, Radiative Transitions/line-emission Polarization	10
4.	Cosmic Radio Sources	radio emission in the Solar System and, the Milky Way, extra-galactic radio sources, Physical mechanism generating radio waves	5
5.	Signal Processing	Fourier pairs in Radio Astronomy, Statistical properties of signal, Probability Density, Expectation Values, Auto-correlation and power spectrum, Filters, digitization and sampling,	4
6.	Antennas and Receivers	Practical aspects of Antenna, Field-of-view, resolution, diffraction patterns, Single-dish telescope, shaped reflectors and antenna arrays	5
7.	Interferometry	resolution, aperture synthesis, survey of radio observatories, VLA, GMRT etc., data analysis pipeline using one of these as an example	6

(C) Pre-requisites, if any: N/A

(D) Short summary for including in the Courses of Study Booklet: Fundamentals of astronomy, Coordinate systems, Structure of the universe, Radio astronomy fundamentals, Stellar Structure and evolution, radiation from astrophysical sources, discrete and continuous spectrum, Electromagnetic wave propagation, cosmic radio sources, statistical prop-

erties of radio signal, Radio telescope Antennas, Reflector Antennas, Antenna arrays, Interferometry and Aperture Synthesis.

7. Recommended Books:

- Radio Astronomy, J. D. Krauss
- Radio telescopes, W. N. Christiansen & J. A. Hogbom
- Interferometry & Synthesis in Radio Astronomy, A. R. Thompson, J. M. Moron & G. W. Swanson

8. Any other remarks:

Dated:                      Proposer:

Dated:                      DUGC/DPGC Convener:

The course is approved/not approved

Chairman, SUGC/SPGC

Dated: