

Indian Institute of Technology, Kanpur Proposal for a New Course

1. Course No: SPA611A
2. Course Title: Radio Astronomy
3. Lectures per week: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional hours: (0-2): 0 (A), Credits ($3*L+3*T+P+A$): 9, Duration of Course: Full Semester
4. Proposing Department: Space Science & Astronomy
5. Proposing Instructor: Pankaj Jain/Avinash Deshpande
6. Course Description
 - (A) Objectives: This is an introductory course in Radio Astronomy. The students are assumed to be familiar with basic Astronomy and Astrophysics. The course will introduce the different types of antennas and receivers used in Radio Astronomy, basic principles of antenna elements and arrays, Imaging, Aperture Synthesis, Deconvolution and CLEAN algorithm, Practical details of analysing single-dish observations and radio interferometric data. 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.	Cosmic Radio Sources	radio emission in the Solar System and, the Milky Way, extra-galactic radio sources, Physical mechanism generating radio waves	5
2.	Signal Processing	Fourier pairs in Radio Astronomy, Statistical properties of signal, Probability Density, Expectation Values, Auto-correlation and power spectrum, Filters, digitization and sampling,	8
3.	Antennas and Receivers	Practical aspects of Antenna, Field-of-view, resolution, single dish observations, spectroscopy, antenna power patterns, antenna arrays, electronic Coherent Receivers, Maximum-power transfer, transmission lines, impedance matching, reflections, Standing-waves, Radio Frequency Interference, time and frequency standards, Noise uncertainties, front and back-ends currently in use	12
4.	Interferometer Response	cross correlation, coherence, convolution, delay and phase compensation, relationship between intensity and visibility, effect of bandwidth	6
5.	Calibration	Basic formalism and methods, use of calibration sources, calibration of amplitude and phase, antenna pointing and gain	6
6.	Imaging	Aperture synthesis, deconvolution and cleaning the data, CLEAN algorithm, practical implementation on VLBI, VLA and GMRT	6

(C) Pre-requisites, if any: SPA610A, Astronomy & Astrophysics

(D) Short summary for including in the Courses of Study Booklet: Fundamental of radio observations, radio antennas and receivers, antenna arrays, Response of an interferometer, cross-correlations, visibility function, calibration techniques, imaging, aperture synthesis, deconvolution, CLEAN algorithm, practical implementation on VLBI, VLA