

Proposal for a new modular course

1. Modular Course No: SPA 636

2. Modular Course Name: Radio instrumentation, observing techniques and data analyses

3. Class strategy: Lectures per week: 0 (L), Tutorial: 2 (T), Laboratory: 1 (P), Additional hours: (0-2): 0 (A), Duration of Course: Full semester, Credit: 5 (3-0-0-0)

4. Proposing department: SPASE

5. Proposing Instructor: Amitesh Omar/ Avinash Deshpande

6. Course Description:

A. Objective: This course aims to provide comprehensive knowledge on instrumentation, observing techniques, and data analyses related to radio astronomy via tutorials and lab experiments. This course will be in the basket of compulsory courses for the PhD students and MTech students.

B. Content:

Tutorials: Each tutorial will be 50 minutes

1. Basics of Radio Astronomy Receivers: Antenna design, Receiver chain, Heterodyning, sampling (3)
2. Signal Processing: Correlation, convolution, Fast Fourier Transform, dynamic spectrum (3)
3. Signal Properties: Noise, coherence, interferometry, complex visibility (3)
4. Radio observations, calibration and data analyses techniques (4)

Lab Component:

The first part of the lab will be devoted to setting up an analog receiver chain and suitable digital backend for data collection, and characterising its performance.

This set up will be used to attempt the following:

1. Spectral-line observation, using HI Horn antenna and employing various calibration techniques (including frequency/load/position switchings, etc)

2. Noise source simulator and cross correlation, to develop hands-on understanding towards interferometry.
3. Two-element/multi-element interferometer, and continuum observations of a sky region and/or specific sources (e.g., Sun).
4. Radio frequency interference detection and mitigation techniques
5. Radio data analyses and estimation of source properties.

In addition, students will be explicitly encouraged to go beyond the above agenda and explore the radio sky.

C. Prerequisites: None

D. Short summary for including in the course study booklet: Radio Astronomy Concepts and Techniques, Receiver systems, Signal Processing, Observations and Calibration.

7. Books and references:

1. *Radio Astronomy*: Kraus
2. *Interferometry and Synthesis in Radio Astronomy*: Thompson, Moran and Swenson