Birla Institute of Technology & Science, Pilani
Hyderabad Campus

1st SEMESTER 2022-23
Course Handout Part II

Date: 29.8.2022

Course No. : **PHY F317**
Course Title : **INTRODUCTION TO RADIO ASTRONOMY**
Instructor in Charge : **Sarmistha Banik**

Objectives & Scope of the Course:
The course aims to give Physics/non-Physics major students an elementary introduction and overview of Radio Astronomy. This is for students who were always curious about the sky out there but never had a chance to know it deeper. And of course, for students who want to pursue their career in Astronomy. We give a general overview of Astronomy and introduce the students to some of the recent and upcoming radio telescope facilities of India and abroad.

Text Book: **Essential Radio Astronomy, Condon and Ransom.** Princeton University Press, [2016] [Also available online https://www.cv.nrao.edu/~sransom/web/xxx.html]

Detailed Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book
1to 5	**Basic Concept of Astronomy**	Celestial coordinates, Constellations, Telescopes, Magnitude scale, Optical Thickness, Hertzsprung--Russell Diagram.	Class notes
6 to 15	**Introduction to Radio Astronomy**	Revision of fundamentals. Radiation Mechanism & Stellar Spectra, Flux density and sky 'brightness', Radiative Transfer-Absorption, Emission, Emission & Absorption in the Atmosphere, Polarization, Blackbody radiation and effective temperature. The Rayleigh-Jeans Law. Planck radiation law, Energy received from an extended source. Why observe at radio wavelengths? Examples of radio sources. Cosmic Microwave Background radiation	TB Chapters 1 &2 , class notes
16 to 22	**Radio Telescopes**	Techniques of Line and continuum observations, Radio telescopes-GMRT, SKA etc.	TB Chapter 3, class notes
23-26	**Antennas and noise**	Antenna power patterns and beams. Effective area and aperture efficiency. Antennas as resistances and Nyquist's Theorem. Antenna temperature and its relationship to sky brightness temperature. Antenna directivity and gain. The Reciprocity Theorem.	TB Chapter 3 Class notes

27-30	**Interferometers**	The need for resolution. Coherence, The Two-Element Quasi-Monochromatic Interferometer	TB Chapter 3, class notes
31-35	**Free-Free Radiation, Synchrotron Radiation**	Thermal and Nonthermal Emission H_{II} Regions Free–Free Radio Emission from H_{II} Regions, Synchrotron Radiation, Inverse-Compton scattering	TB Chapters 4, 5 class notes
36 to 40	**Pulsar timing array**	Pulsar Properties & Discovery, Neutron Star Masses and Densities, Magnetic Fields, Magnetic Dipole Radiation Spin-Down Luminosity, Minimum Magnetic Field Strength, Characteristic Age Braking Index, The Lives of Pulsars, Emission Mechanisms Pulsars and the Interstellar Medium, Pulsar Observation and Pulsar timing technique	TB Chapter 6, class notes

5. Evaluation Scheme:

	Evaluation	Duration	Weight age (%)	Date, Time	Nature of Component
1.	Mid-Sem	90 mins.	30.00%	03/11 1.30 - 3.00PM	Closed Book
3.	Quiz	50 minutes	10.00%	TBA	Open Book
4	Project/Seminar	NA	20.00%	TBA	Open Book
5	Comprehensive Examination	180 mins.	40.00%	26/12 AN	Closed Book

6. Chamber Consultation Hour: TBA

7. Notices: Notices for the course will be displayed on CMS.

8. Make-up Policy: Make up for Mid-Sem and Compre will be given to emergency (hospitalization) case only, if forwarded by chief warden. Make up requests should reach the IC before the examination.

9. **Academic honesty and integrity policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge
PHY F317