**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:**

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| --- | --- | --- | --- |
| **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  HII Regions  Free–Free Radio Emission from HII 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:

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| --- | --- | --- | --- | --- | --- |
|  | 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**

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