

## **DSE: Astronomy and Astrophysics (32227506)**

**Credit : 06 (Theory-05, Tutorial-01)**

**Theory : 75 Hours**

**Tutorial : 15 Hours**

### **Course Objective**

This course is designed to provide students with the basic knowledge about the theory and techniques of observational astronomy and physics of the astrophysical phenomenon. It applies theoretical concepts and mathematical techniques students have learnt in their earlier courses to astronomical and astrophysical phenomenon.

### **Course Learning Outcomes**

Students completing this course will gain an understanding of

- Different types of telescopes, diurnal and yearly motion of astronomical objects, and astronomical coordinate systems and their transformations.
- Brightness scale for stars, types of stars, their structure and evolution on HR diagram.
- Components of Solar System and its evolution
- The large scale structure of the Universe and its history
- Distribution of chemical compounds in the interstellar medium and astrophysical conditions necessary for the emergence and existence of life.

### **Unit 1**

**Introduction to Astronomy and Astronomical Scales:** Overview of the Night Sky, Diurnal and Yearly motions of the Sun, Stars and Constellations. Size, Mass, Density and Temperature of Astronomical Objects. Basic concepts of Positional Astronomy: Celestial Sphere, Geometry of a Sphere, Spherical Triangle, Astronomical Coordinate Systems, Horizon System, Equatorial System, Conversion of Coordinates. Rising and Setting Times, Measurement of Time, Sidereal Time, Apparent Solar Time, Mean Solar Time, Equation of Time, Astronomical Time Systems (LMT, UT, UTC).

**(16 Lectures)**

### **Unit 2**

**Basic Parameters of Stars:** Determination of Distance by Parallax Method; Proper Motion, Brightness, Radiant Flux and Luminosity, Apparent and Absolute Magnitude Scales, Distance Modulus, Extinction, Determination of Temperature and Radius of a star; Stellar Spectra, Atomic Spectra Revisited, Introduction to Boltzmann and Saha Equations, Balmer Lines of H, H and K lines of Ca, Spectral Types and Their Temperature Dependence, Black

Body Approximation, Luminosity Classification, H R Diagram and Relations Between Stellar Parameters.

(16 Lectures)

### Unit 3

**Observational Tools and Physical Principles:** Observing through the atmosphere (Scintillation, Seeing, Atmospheric Windows and Extinction) Basic Optical Definitions for Telescopes: Magnification, Light Gathering Power, Limiting magnitude, Resolving Power, Diffraction Limit. Optical and Radio Telescopes, Current Indian Observatories. Virial theorem for N particle systems, applications in astrophysics. Systems in Thermodynamic Equilibrium, Equations for Hydrostatic equilibrium, Mean Molecular Weight of stellar gas, Stellar Energy Sources.

(16 Lectures)

### Unit 4

**Sun and the Milky Way:** Solar Parameters, Sun's Internal Structure, Solar Photosphere, Solar Atmosphere, Chromosphere. Corona, Solar Activity, Solar Magneto-Hydrodynamics, Alfven's Theorem. Basic Structure and Properties of the Milky Way, Nature of rotation of the Milky Way (Differential rotation of the Galaxy and Oort Constants, Rotation Curve of the Galaxy and the Dark Matter, Nature of the Spiral Arms), Properties of and Around the Galactic Nucleus.

(15 Lectures)

### Unit 5

**Cosmology:** Standard Candles (Cepheids and SNe Type Ia), Cosmic Distance Ladder, Olbers Paradox, Hubble Expansion, Cosmological Principle, Newtonian Cosmology and Friedmann Models

(12 Lectures)

### References for Theory :

#### Essential Readings :

1. Fundamental of Astronomy (Fourth Edition), H. Karttunen et al. Springer
2. Astrophysics Stars and Galaxies K D Abhyankar, Universities Press
3. Modern Astrophysics, B.W. Carroll & D.A. Ostlie, Addison-Wesley Publishing Co.
4. Baidyanath Basu, An introduction to Astrophysics, Second printing, Prentice - Hall of India Private limited, New Delhi, 2001.
5. Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, 4th Edition, Saunders College Publishing.

#### Additional Readings:

1. Explorations: Introduction to Astronomy, Thomas Arny and Stephen Schneider, 2014, 7<sup>th</sup> edition, McGraw Hill
2. Principles of Stellar Dynamics, S Chandrasekhar, Dover Books
3. The Physical Universe: An Introduction to Astronomy, F H Shu, University Science Books
4. Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, Narosa Publication.