

## DISCIPLINE SPECIFIC ELECTIVE COURSE – DSE 6: ASTRONOMY AND ASTROPHYSICS

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Astronomy and Astrophysics DSE – 6	4	3	1	0	Class XII pass with Physics and Mathematics as main subjects	Mechanics; Waves and Oscillation; Electricity & Magnetism; Mathematical Physics papers of this course or their equivalents

### LEARNING OBJECTIVES

This course is meant to introduce undergraduate students to the wonders of the Universe. Students will understand how astronomers over millennia have come to understand mysteries of the universe using laws of geometry and physics. They will also be introduced to the Indian contribution to astronomy in the modern times, techniques to measure astronomical parameters, the different layers of the Sun and an overview of our Milky Way galaxy.

### LEARNING OUTCOMES

After completing this course, student will gain an understanding of,

- Basic concepts of positional astronomy and astronomical coordinate systems
- Astronomical instruments and the modern telescopes
- Measurement of astronomical parameters such as distance, stellar brightness, stellar mass, radii, temperature and spectra
- The different layers of solar atmosphere and basic results of solar magneto-hydrodynamics
- Basic structure of different galaxies and rotation of the Milky Way galaxy

It is advised that the tutorial sessions should involve discussion on problems meant to help students develop the ability to apply the theory they learn in lectures to diverse astrophysical phenomenon.

### SYLLABUS OF DSE - 6

#### THEORY COMPONENT

##### **Unit – I - Introduction to Astronomy (12 Hours)**

Overview of the night sky; diurnal and yearly motions of the Sun; basic concepts of positional astronomy: celestial sphere, astronomical coordinate systems (Horizon and Equatorial systems of coordinates), circumpolar stars

##### **Unit – II - Basic Parameters of Stars (12 Hours)**

Measurement of astronomical distances (stellar parallax, aberration, proper motion), measurement of brightness, radiant flux and luminosity (apparent and absolute magnitude scales; distance modulus); determination of stellar mass (visual binaries, eclipsing binaries, spectroscopic binaries); measurement of stellar temperature and radius; stellar spectra,

dependence of spectral types on temperature; Stellar classification (Harvard classification scheme), H-R diagram

**Unit – III - Sun** **(9 Hours)**

Solar parameters, Sun's internal structure, solar photosphere, solar atmosphere, chromosphere, corona, solar activity, basics of solar magneto-hydrodynamics

**Unit – IV - Physics of galaxies** **(12 Hours)**

Nature of rotation of the Milky Way: Differential rotation of the Galaxy and Oort constants, rotation curve of the Galaxy and the dark matter, virial theorem

Cosmology: Standard Candles (Cepheids and SNe Type 1a); cosmic distance ladder; expansion of the Universe, Cosmological principle, Newtonian cosmology and Friedmann models

**References:**

**Essential Readings:**

- 1) Fundamental Astronomy, H. Karttunen et al., Springer Berlin, Heidelberg
- 2) Modern Astrophysics, B. W. Carroll and D. A. Ostlie, Addison-Wesley Publishing Co.
- 3) Introductory Astronomy and Astrophysics, M. Zeilik and S. A. Gregory, Saunders College Publishing.
- 4) Astronomy in India: A Historical Perspective, T. Padmanabhan, Springer
- 5) Foundation of Astrophysics, B. Ryden and B. M. Peterson, Cambridge University Press
- 6) Astronomy: A Physical Perspective, M. Kutner, Cambridge University Press

**Additional Readings:**

- 1) Seven Wonders of the Cosmos, J. V. Narlikar, Cambridge University Press
- 2) Explorations: Introduction to Astronomy, T. Arny and S. Schneider, McGraw Hill
- 3) Astrophysics Stars and Galaxies, K. D. Abhyankar, Universities Press
- 4) An introduction to astrophysics, B. Basu, Prentice Hall of India Private Limited.
- 5) The Physical Universe: An Introduction to Astronomy, F. H. Shu, University Science Books
- 6) Telescopes and techniques, C. R. Kitchin, Springer New York, NY
- 7) Fundamentals of solar astronomy, A. Bhatnagar and W. C. Livingston, World Scientific
- 8) Astrophysics for Physicists, A. R. Choudhuri, Cambridge University Press