

DISCIPLINE SPECIFIC ELECTIVE COURSE – PHYSICS DSE 15a: FOUNDATION OF ASTROPHYSICS

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Foundation of Astrophysics PHYSICS DSE 15a	4	3	1	0	Class XII pass with Physics and Mathematics as main subjects	Mechanics; Electricity & Magnetism; Waves and Optics 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, the characteristics of planets in the solar system, an overview of our Milky Way galaxy and astrobiology.

LEARNING OUTCOMES

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

- Basic concepts of positional astronomy and astronomical coordinate systems
- Astronomical instruments and modern telescopes
- Measurement of basic astronomical parameters such as distance, stellar brightness, stellar mass, radii, temperature and spectra
- Different layers of the Sun's atmosphere
- The difference between the terrestrial planets and the Jovian planets
- Basic structure of different galaxies and rotation of the Milky Way galaxy
- Distribution of chemical compounds in the interstellar medium and astrophysical conditions necessary for the emergence and existence of life

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 PHYSICS DSE – 15a

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 (15 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 by Kepler's law; 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 and the solar system (9 Hours)

Solar parameters; Sun's internal structure; solar photosphere; solar atmosphere; chromosphere; corona; solar activity; solar system (characteristics of terrestrial and Jovian planets)

Unit – IV- Physics of galaxies, Cosmology, Astrobiology (9 Hours)

Physics of galaxies: Nature of rotation of the Milky Way: Differential rotation of the Galaxy, dark matter

Cosmology: Standard Candles (Cepheids and SNe Type Ia); cosmic distance ladder; expansion of the Universe

Astrobiology: History of the Universe; chemistry of life; origin of life; chances of life in the solar system

References:

Essential Readings:

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

Additional Readings:

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