BACHELORS WITH PHYSICS AS MAJOR
6th SEMESTER

PHY622J3 PHYSICS _ ASTROPHYSICS

CREDITS: THEORY – 4, TUTORIAL - 2

THEORY (4 CREDITS: 60 HOURS)

LEARNING OUTCOMES:

The learning outcomes cover a wide range of topics in astrophysics and stellar astronomy, providing students with a strong foundation in understanding celestial objects, stellar properties, and the evolution of stars and cosmic objects.

1. *Understand the concept of the celestial sphere and its role in representing the sky.*
2. *Explain the different coordinate systems used in astronomy, including the horizon, equatorial, ecliptic, and galactic systems.*
3. *Apply the principles of spherical trigonometry to solve problems related to celestial objects and their positions.*
4. *Identify and describe constellations, and use the nomenclature of stars.*
5. *Understand the methods for measuring distances to stars, including trigonometric parallax.*
6. *Explain the concept of stellar magnitude and magnitude systems used in astronomy.*
7. *Discuss atmospheric extinction and its effects on observations.*
8. *Understand the spectral classification of stars and its significance in characterizing stellar properties.*
9. *Explain the Virial Theorem and its implications for stellar equilibrium.*
10. *Understand the equations of energy transport, thermal equilibrium, and state of stars.*
11. *Apply Jean's criteria for stability to understand the formation of stars.*
12. *Describe different types of binary star systems and methods for determining the masses of binary stars.*
13. *Explain the fate of massive stars, including the concepts of supernovae, white dwarfs, and the Chandrasekhar limit.*
14. *Introduce the concepts of neutron stars, pulsars, and black holes, focusing on qualitative aspects of these cosmic objects.*

Unit-I (15 HOURS)

Celestial sphere, The cardinal points and circles on the celestial sphere, Horizon, Equatorial, Ecliptic and galactic system of co-ordinates. Spherical triangle and related problems.
Constellations and nomenclature of stars. Twilight, Seasons. Sidereal time.

Unit-II (15 HOURS)

Stars-general Distances to stars; trigonometric parallax, Stellar motions, Magnitude scale and magnitude systems. Atmospheric extinction. Absolute magnitudes and distance modulus. spectral classification of stars.

Unit-III (15 HOURS)

Fundamental equations; Equation of mass distribution. Equation of hydrostatic equilibrium. Virial Theorem. Equation of energy transport, Equation of thermal equilibrium. Equation of state. Stellar Opacity. Stellar energy sources. Polytropic model.

Unit-IV (15 HOURS)

Evolution of stars, interstellar dust and gas, Jean's criteria for stability, formation of stars, Binary stars (different binary systems), masses of binary stars, Fate of massive stars, Supernovae, White dwarfs, Chandrashekar limit. Neutron stars, Pulsars, black holes (qualitative).

TUTORIALS (2 CREDITS: 30 HOURS)

1. Equation of time: Apparent and Mean solar time and their relations.
2. M- K classification scheme of stars,
3. HR diagram.
4. Variable stars as distance indicators.
5. Lane-Emden equation and its solution, Central temperature and pressure.
6. Evolution of stars on the basis of HR diagram

TEXT BOOKS:

1. Stellar Structure. S. Chandrasekhar;
2. An Introduction to Astrophysics, Baidyanath Basu;
3. An introduction to Modern Astrophysics, Bradley W. Carroll & Dale A. Ostlie;
4. Principles of Stellar Interiors – Vol. I & II., Cox and Guili;
5. Astrophysics: Stars and Galaxies., K. D. Abhyankar;
6. Stellar Structure and Evolution., R. Kippenhahn A. Weigert;