MANGALORE UNIVERSITY

Department of Physics

MSc Physics

PHH 552: ASTROPHYSICS AND RELATIVITY

(52 Hrs.)

Course outcome

CO1 The student will have good understanding of basics of astrophysics.

CO2 Good understanding of energy generation in stars.

CO3 Will be well versed with general theory relativity.

Unit I Astrophysics

Introduction – constellations, solstices, equinoxes, zodiac, temperature of stars and their classification, visible and invisible astronomy.

Doppler effect. Hubble's law. Origin and evolution of solar system. Apparent and absolute magnitudes of stars. Measurement of stellar distances – method of heliocentric parallax, statistical parallax method. Spectroscopic parallax method. [13hrs]

Unit II Energy generation in stars. Contents of milky way galaxy

Hertzsprung – Russel diagram – Evolution of stars – star birth, evolution to, on and off the main sequence, evolution to the end.

White dwarfs, neutron stars, pulsars and black holes.

Cosmological models – steady state and Big-Bang models. [13 hrs]

Unit III Theory of relativity

Special theory : review – postulates of special theory of relativity, relativity of simultaneity and Lorentz transformation equation of lengths perpendicular and parallel to relative motion; time intervals, transformation of velocities and acceleration. Equivalence of mass and energy.

4 dimensional formulation of theory of relativity - Lorentz transformation, length contraction, time dilation, covariance of laws of nature. 4 dimensional line element. 4 velocity, 4 acceleration, 4 momentum and 4 force.

Inertial and gravitational mass. Eotvos experiment. [13 hrs]

Unit IV General relativity

Tensor calculus – Christoffel symbols – covariant differentiation of tensors – the equation of geodesic line – the Riemann – Christoffel tensors – transformation laws for the Christoffel symbols. Maxwell's equation in tensor form.

Principles of equivalence and covariance. Schwarzschild line element. Schwarzschild radius. Tests for the theory of relativity – Advance of perihelion, gravitations shift of spectral lines. Experiment of Rebka and Pound. [13 hrs]

Text Books:

1. Introduction to Astrophysics 'BaidyanathBasu' (PHI, 1997).
2. Michael Feilik and John Gaustad 'Astronomy the Cosmic Prospective' (John Wiley & Sons, Inc., 1990)
3. Resnik R, 'Introduction to Special Relativity' (Wiley Eastern, 1972)
4. Rindler W, 'Introduction to Special Relativity', II Edn. (Oxford University Press, 1991)

Reference Books:

1. Schutz B F, 'A First Course in General Relativity' (Cambridge University Press, 1985)
2. Feilik M, 'Astronomy – the Evolving Universe' III Edn (Harper and Row, 1982)
3. Boris A Vorontsov-Vel'yaminov, 'Essay about the Universe' (Mir Publishers, Moscow, 1985)
4. French A P, 'Special Relativity' (Thomas Nelson, 1968)
5. Moller C, Theory of Relativity II Edn. (Claredon Press, 1972)
6. Jean-Pierre-Luminet 'Black Holes' (Cambridge University Press, 1987)
7. D Mc Gillivray 'Physics and Astronomy' (McMillan, 1987)
8. Michael Berry 'Principles of Cosmology and Gravitation' (Cambridge University Press, 1976)
9. Rosser W G V, 'An Introduction of the Theory of Relativity' (ELBS – Butterworth, 1972)
10. Lord EA, Tensorl, Relativity and Cosmology' (Tata McGraw Hill, 1976)
11. Ray d'Inverno, 'Introducing Einstein's Relativity' (Oxford University Press, 1992)
12. Dixon W G, 'Special Relativity, the Foundation of Modern Physics' (Cambridge University Press, 1978)
13. Adler R, Bazin M & Schiffer M, 'Introduction to General Relativity', II Edn. (McGraw Hill, 1975)
14. Hughston L P and Tod K P, 'An Introduction to General Relativity' (Cambridge University Press)
15. Hans Stephani, 'General Relativity' II Edn. (Cambridge University Press, 1990)
16. Peter Gabrial Bergmann 'Introduction to theory of Relativity' (PHI, 1989)
17. Nigel Henbest and Heather Couper 'The Restless Universe' (George Philip, 1982)
18. Jagjit Singh. 'Great Ideas and Theories of Modern Cosmology' (Dover Publications, Inc., 1961)

19. Marc L Kutner “Astronomy a physical perspective (2nd edition) Cambridge University Press 2003.