

**AS108: General Theory of Relativity(14 lectures in 21 hrs)**

*(A certificate course for UG, PG and PG+ students)*

**Instructors: A. Bhattacharjee**

**Teaching assistants: S. Chakraborty, S. Biswas, K. Belwal, M. Bisht**

**Mode of Instruction: English**

**Syllabus**

***Equivalence Principle(1 Lecture)***

**Instructor: A. Bhattacharjee**

Equivalence of gravitational and inertial mass; Principle of general covariance.

***Tensor Analysis(2 Lectures)***

**Instructor: A. Bhattacharjee**

Covariant and contravariant tensors; Metric tensor; Tensor densities; Volume and surface integrals; Christoffel symbols; Parallel transport and covariant differentiation; Riemann curvature tensor; Differential identities.

***Special Theory of Relativity(2 Lectures)***

**Instructor: A. Bhattacharjee**

Spacetime interval; Principle of relativity; Lorentz transformations; Spacetime diagrams; Particle dynamics.

***Einstein's Field Equations(2 Lectures)***

**Instructor: A. Bhattacharjee**

Einstein-Hilbert action; Einstein's equations; Newtonian weak-field limit; Cosmological constant; Weyl tensor and the propagation of gravity.

***Schwarzschild Solution(3 Lectures)***

**Instructor: A. Bhattacharjee**

Metric of a spherically symmetric spacetime; Static geometry and Birkhoff's theorem; Effective potential for orbits in the Schwarzschild metric; Perihelion shift of Mercury, Sun's quadrupole moment; Null geodesics and Fermat's principle.

***Kerr Solution(2 Lectures)***

**Instructor: A. Bhattacharjee**

General stationary axis-symmetric metric; Dragging of inertial frames; Static limit and infinite redshift surface; Kerr metric; Geodesics in the equatorial plane; Penrose process and the area of the event horizon.

***Basic Cosmology(2 Lectures)***

**Instructor: A. Bhattacharjee**

Cosmological principle; FRW metric; Redshift of galaxies and Hubble's law; Friedmann equations and standard models; Age of the universe; Critical density.

***Sitapur Observatory trip(1 night)***

**Instructors: Devendra Bisht, Ashish Raj, Kuldeep Belwal, Mohit Bisht, Shraddha Biswas**

Discussion on the observables in the night sky, software guided observation using optical telescopes; hands-on experience on telescope assembling.