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

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

Instructors: *A. Bhattacharjee*

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.

Schwarzwald Solution ***(3 Lectures)***

Instructor: A. Bhattacharjee

Metric of a spherically symmetric spacetime; Static geometry and Birkhoff's theorem; Effective potential for orbits in the Schwarzwald metric; Perihelic 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, Kuldeep Belwal, Mohit Bisht, Shraddha Biswas, Soumojit Tiwari

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