Syllabus: General Relativity and Cosmology

(PhD Course Work, ISI)

1) Preliminaries: Why GR, Space-time curvature, Einstein's equations, Spherically symmetric geometry, Static spherically symmetric pathology.

2) Advanced topics: Gravitational collapse; Gravitational lensing: lensing geometry, magnification and shear, applications; Gravitational waves: propagation of fluctuations, radiation emission, radiated power, indirect and direct detection techniques.

3) Basic cosmology: Friedmann equations, Observables and measurements, Survey of present status of observational cosmology.

4) Early universe: Inflationary paradigm, Slow roll technique and model building algorithm, Quantum fluctuations and observable parameters, Construction of inflationary models and typical examples.

5) Cosmic Microwave Background radiation: Generation of temperature anisotropies and reflection on CMB multipoles, Adiabatic and isocurvature modes, CMB polarization, Lensing in CMB, Cosmological parameters from CMB: observational status.

6) Post-inflationary perturbations: Perturbations in geometry and matter, Evolution of super-Hubble and sub-Hubble modes, Sachs Wolfe (and Integrated Sachs Wolfe) effect, Baryon acoustic oscillations, Transfer function and numerical fit.

7) Estimation of power spectra: Gaussian and non-gaussian distributions, Links to CMB and galaxy redshift surveys.

8) Dark energy: Different dark energy models: pros and cons; Reconstruction of parameters; Observational status: reflection in

SNIa, CMB and growth of structures; Chi-square analysis; Dark energy perturbations.

9) Statistical tools: Bayesian methods and maximum likelihood analysis, Cross-correlation of data, Evidence calculation and model discrimination techniques, Application to CMB and Dark energy surveys.