University of Illinois at Urbana-Champaign
DEPARTMENTS OF PHYSICS AND ASTRONOMY
COURSE ANNOUNCEMENT

PHYSICS 515 / ASTRO 515

GENERAL RELATIVITY I

Fall Semester 2011
Call Numbers: Physics 34931/Astronomy 34932
Credit: 1 Unit or 4 Hours
Time: M-W, 1:00 p.m.– 2:20 p.m.
Room: 144 Loomis Lab

AND

PHYSICS 516 / ASTRO 516

GENERAL RELATIVITY II

Spring Semester 2012
Call Numbers: TBD
Credit: 1 Unit or 4 Hours
Time: Tu-Th, 11 a.m.– 12:20 p.m.
Room: 144 Loomis Lab

Professor Stuart L. Shapiro

A comprehensive, two-semester sequence on the theory of general relativity. The first semester develops the mathematical tools and the underlying physical concepts. The second semester applies the formalism to study black holes, gravitational radiation, cosmology and other topics of current interest.

The first semester is a systematic introduction to Einstein's theory, with emphasis on modern coordinate-free methods of computation. Topics include: review of special relativity, modern differential geometry, foundations of general relativity, laws of physics (e.g., electromagnetism, hydrodynamics, kinetic theory) in the presence of a gravitational field, linearized theory, and experimental tests of gravitation theories. The second semester is a continuation of the first with emphasis on applications to relativistic astrophysics and cosmology. Topics include: relativistic stars, gravitational collapse, black holes, the generation and detection of gravitational waves (LIGO and LISA), numerical relativity and cosmology (big-bang expansion, dark energy and dark matter, inflation, nucleosynthesis, CMB).

Target: The course is aimed at beginning graduate students and advanced undergraduates. No specific background is required and all the necessary mathematical machinery (e.g. differential geometry) will be developed. The course will provide all students with a firm foundation and an ability to calculate. It is designed not only for those who may wish to pursue theoretical research in relativity or astrophysics but also for experimenters and observers who need a background in relativity or cosmology, as well as high-energy physicists, field theorists, string theorists, mathematical and computational physicists who wish to study the structure and physical consequences of an elegant and successful nonlinear, classical gauge theory.
The course is given on alternate years.

Text: At the level of *"Gravitation"* by Misner, Thorne and Wheeler.