## **School of Mathematics**

Course 442 - Differential Geometry and General Relativity 2006-07 (Optional JS & SS Theoretical Physics, JS & SS Mathematics )

Lecturer: Dr. Calin Lazariou

**Requirements/prerequisites:** Analytical mechanics (241) and Classical Electrodynamics (432); Differential Geometry (manifolds, vector and tensor fields, differential forms and vector bundles)

Duration: 21 weeks.

Number of lectures per week: 3

Assessment:

End-of-year Examination: One 3-hour examination

**Description:** The course is an introduction to general relativity.

**Course content:** Elements of pseudoriemmanian geometry (Einstein metrics and Minkowski manifolds, causal structure, Levi-Civita connection, Ricci and curvature tensors) Einstein equations, stress-energy tensor, positivity conditions, Cauchy hypersurfaces The principle of equivalence; experimental and observational evidence for general relavity Matter systems coupled to gravity (relativistic fluid, electromagnetic fields) Special solutions of Einstein's equations (Schwarzchild, Kerr, Reisner-Nordstrom, Robertson-Walker)

Advanced topics (as time allows): singularities, completeness, no-hair teorems, gravitational waves etc.

## Core textbook:

R.K. Sachs, General Relativity for Mathematicians, Graduate Texts in Mathematics vol 48, Springer, 1977

Recommended: Hawking and Ellis, The large scale structure of space-time Landau and Lifschitz, The Classical Theory of Fields

February 27, 2007