

## PHY 405 Geometrical Methods in Physics

### Pre-requisites

You should know linear algebra (eg., as used in quantum mechanics ) and the calculus of several variables (partial derivatives, multidimensional integration). Some knowledge of thermodynamics, classical mechanics and quantum mechanics at the level of our junior level courses will also be assumed.

There will be no examinations in the course; instead there will be some homework assignments. Reading some research papers and some advanced textbooks will be required. The course will be graded on a Pass/Fail basis.

The first part of the course will be accessible to undergraduates and to experimental physics graduate students. The later parts will aim to bring the subject up to the level of modern research papers in mathematical physics.

Syllabus on next page.

## Syllabus

- Review of Linear Vector algebra; tensors; wedge products.
- Index notation for tensors.
- Curvilinear Co-ordinates in flat space.
- The Sphere; geodesics on the sphere.
- Differential Manifolds.
- Vector Fields.
- Thermodynamics: Caratheodory's form of the second law of thermodynamics.
- Mechanics; Special Relativity.
- Riemannian Geometry; Geodesics.
- Parallel Transport and Curvature.
- Geometrical Optics.
- Electrodynamics.
- General Relativity.

Special Topics that will be mentioned if time permits...Contd next page

### Optional Special Topics

- Cohomology.
- Supersymmetric Quantum Mechanics.
- Witten's approach to Morse Theory.
- Lie Groups.
- Poisson Brackets.
- Deformation Quantization.