COURSE ANNOUNCEMENT
Mathematics 665 (Winter)
Mathematics 666 (Spring)

Course Name: Modern Mathematical Methods in Relativity Theory I, II (a.k.a. "Applied Differential Geometry")

Class Number: 26482

Time: Winter 2011, MWF 12:30-1:50pm

Credits: 4 per quarter

Prerequisites:

Calculus and linear algebra (e.g. Math 568 and/or 601).

A physics course (e.g. Physics 133 or higher).

No prior knowledge of tensor calculus is assumed. However, we do assume a mature attitude towards mathematics and physics.

Audience: Undergraduate and graduate

Goal and Purpose:

a) To learn and appreciate the mathematical chapters of our primary text ("*Gravitation*" by MTW, see references below), thus to develop an appreciation and the modern mathematical framework for the description of the spacetime continuum. The development will focus on (1) the underlying differential geometric framework of spacetime, and (2) the formulation (motivated from classical mechanics, fluid dynamics, and wave mechanics) for identifying its properties.

b) To provide, among others, an introduction for independent work dealing with geometric dynamical processes (wave, fluid, hydro) in flat or curved spacetimes.

Website: `http://www.math.ohio-state.edu/~gerlach/math665`

DESCRIPTION

Math 665:

- A rapid course in special relativity: spacetime geometry, event horizons and accelerated frames;
- tensors, metric geometry vs symplectic geometry;
- exterior calculus, Maxwell field equations;
- manifolds, Lie derivatives, and Hamiltonian dynamics in phase space;
- tangent bundle, parallel transport, torsion;
- curvature and Jacobi's equation of geodesic deviation;
- Cartan's two structural equations, metric induced properties, and Cartan-Misner curvature calculus.

Math 666:

- Geodesics: Hamilton-Jacobi theory, the principle of constructive interference;

- stress-energy tensor: hydrodynamics in curved spacetime and Einstein field equations;
- some of their solutions: stars, black holes, gravitational collapse, geometry and dynamics of the universe;
- vector harmonics, tensor harmonics, acoustic and gravitational waves in violent relativistic backgrounds.

Textbooks:

(a) *Gravitation* by C. W. Misner, K. S. Thorne, and J. A. Wheeler.

(b) Selections from *Mathematical Methods of Classical Mechanics* by V. I. Arnold.

(c) Selections from *Lecture Notes on Elementary Topology and Geometry* by I. M. Singer.

(d) Selections from *Spacetime Physics*, 2nd edition, by E. Taylor and J.A. Wheeler

I am glad to answer any questions.
Ulrich Gerlach

Telephone: 292-2560 or 292-3572

FAX: 292-1479

e-mail: gerlach@math.ohio-state.edu