

**Geometrical methods in theoretical physics (1FA153)**  
PhD and MSc course, 10 hp

**Course plan**

**Lecture 1** topological spaces, homotopy groups, homology groups

**Lecture 2** smooth manifolds, de Rham cohomology groups, Hodge theory

**Lecture 3** complex manifolds

**Lecture 4** Lie groups, action of Lie group on a manifold

**Lecture 5** fiber bundles, principal bundles, vector bundles

**Lecture 6** connections on fiber bundles

**Lecture 7** characteristic classes

**Lecture 8** reserved to catch up with the material

**Lecture 9** Yang-Mills theory, instantons, monopoles

**Lecture 10** Index theorems and anomalies

**Lecture 11** special holonomy manifolds, Calabi-Yau manifolds

**Lecture 12** elements of algebraic geometry

**Lecture 13** equivariant cohomology and fixed point theorems

**Lecture 14** reserved to catch up with the material

**Lecture 15** supersymmetric quantum mechanics

## **Literature**

the main book for the course is

**M.Nakahara, "Geometry, Topology and Physics"**

Also the following books are recommended

**C.Nash, "Differential topology and Quantum Field Theory"**

**K.Hori et.al., "Mirror symmetry"**

**A.Schwarz, "Quantum Field Theory and Topology"**

## **Teacher**

Maxim Zabzine, 018-471 32 47      Maxim.Zabzine@physics.uu.se

## **Exam**

There will be four home assignments during the course.

## **Homepage**

[www.physics.uu.se/forskning/teoretisk-fysik/medarbetare/mzabzine-webpage/gmtp/](http://www.physics.uu.se/forskning/teoretisk-fysik/medarbetare/mzabzine-webpage/gmtp/)