LUND UNIVERSITY

FACULTY
OF SCIENCE

General Relativity for Mathematicians, 7.5 credits

Allmän relativitetsteori för matematiker, 7,5 högskolepoäng

Third Cycle/Forskarnivå

Learning outcomes

The aim of the course is to give the participant a mathematical presentation of general relativity, that is, spacetime-geometry-based gravitation theory.

On completion of the course, participants shall be able to:

Knowledge and understanding

- *Give an account of the field equation, the energy momentum tensor, types of matter distributions.*
- *Describe the tests of general relativity.*
- *Give an account of Schwarzschild black holes and the Friedmann-Lemaitre-Robertson-Walker cosmological model.*

Competence and skills

- *State definitions and theorems in semi-Riemannian geometry relevant to general relativity.*
- *Perform local differential geometry calculations.*
- *Derive and solve the geodesic equation for simple spacetimes.*

Course content

The course will cover the following topics:

- *Smooth manifolds*
- *Tangent and cotangent space*
- *Tangent and cotangent bundles*
- *Tensor fields*
- *Lorentzian manifolds*
- *Levi-Civita connection*

- *Parallel transport*
- *Geodesics*
- *Curvature*
- *Form fields*
- *Integration*
- *Minkowski spacetime physics*
- *Matter*
- *Field equation*
- *Black holes*
- *Cosmology*

Forms of instructions

Teaching consists of *lectures* and self-study via problem solving.

Forms of assessment

The assessment is based on *written* performance in a *written exam.*.

Grades

Possible grades are Pass and Fail. For a grade of Pass, the student must have passed *the written exam*.

Language of instruction

The course is given in *English*.