

# Theory of Relativity

Programme course

6 credits

Relativitetsteori

TATA75

Valid from: 2018 Spring semester

**Determined by**

Board of Studies for Electrical  
Engineering, Physics and Mathematics

**Date determined**

## Main field of study

Mathematics, Applied Mathematics, Applied Physics, Physics

## Course level

Second cycle

## Advancement level

A1X

## Course offered for

- Physics and Nanoscience, Master's Programme
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering

## Specific information

The course is only offered every second year. It will be offered during 2016.

## Prerequisites

Mechanics, Modern Physics.

In addition to these formal prerequisites considerable 'mathematical maturity' is required. Therefore it is advantageous to have taken one or several additional courses in advanced mathematics and theoretical physics e.g., Complex analysis, Differential geometry, Functional analysis, Cosmology and/or Analytical mechanics.

## Intended learning outcomes

The purpose of the course is to give a good understanding of the principles and consequences of the special and general theory of relativity. After a finished course the student knows how to:

- use the relativistic introductory four formalism to solve problems within the special relativity
- use the mathematical formalism for connections and general tensors (like the Riemann tensor) to solve problems of general relativistic nature
- explain the physical principles that form the foundation for general relativity and derive their consequences for the field equations and equations of motion
- derive the physical consequences of general relativity from the field equations and equations of motion, especially the classical tests of the theory, black holes and relativistic cosmology
- derive the main exact solutions of Einsteins field equations

## Course content

Manifolds. Tensor algebra. Tensor analysis. Metric tensor.

Geodesics. Riemann tensor. Calculus of variations. The postulates of special relativity. Lorentz-transformations. Physical consequences of special relativity. The postulates of general relativity. Einstein's field equations and equations of motion. Weak-field approximation. Schwarzschild's solution. Planetary motion and the perihelion drift of Mercury. Deviation of light. Gravitational redshift. Time dilation. Singularities. Static and rotating black holes. Relativistic cosmology.

## Teaching and working methods

The course is presented on lectures.

## Examination

UPG1 Homework problems and oral presentation 6 credits U, 3, 4, 5

## Grades

Four-grade scale, LiU, U, 3, 4, 5

## Department

Matematiska institutionen

## Director of Studies or equivalent

Göran Forsling

## Examiner

Fredrik Andersson

## Course website and other links

<http://www.mai.liu.se/und/kurser/index-amne-tm.html>

## Education components

Preliminary scheduled hours: 38 h

Recommended self-study hours: 122 h

## Course literature

FR D'Inverno: Introducing Einsteins Relativity, Clarendon

## Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at [http://stydokument.liu.se/Regelsamling/Innehall/Utbildning\\_pa\\_grund-\\_och\\_avancerad\\_niva](http://stydokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva).