Faculty of Science

FYTN16, Theoretical Physics: Classical Mechanics, 7.5 credits

Teoretisk fysik: Klassisk mekanik, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus is an old version, approved by Study programmes board, Faculty of Science on 2021-01-31 and was valid from 2021-01-31 , autumn semester 2021.

General Information

The course is an elective course for second-cycle studies for a Degree of Master of Science (120 credits) with a specialisation in physics.

Main field of studies	*Depth of study relative to the degree requirements*
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

The overall aim of the course is to give the student a solid knowledge of Lagrange and Hamilton formulations of classical mechanics with connections to field theory and relativity.

Knowledge and understanding

Upon completion of the course, the student shall be able to:

- describe the reduction of the central force problem for two bodies to the equivalent one-body problem, the equations of motion and its solution,
- explain rigid body motion and how it leads to Euler's equations,
- describe the Lagrange formalism for a particle in a relativistic formulation,
- explain the principle behind canonical transformations and how it leads to the Hamilton-Jacobi equation and action angle variables,
- explain the principles behind time-dependent and time-independent perturbation theory,
- describe the Lagrange/Hamilton formulation for continuous systems in a general way.

Competence and skills

Upon completion of the course, the student shall be able to:

- explain d'Alembert's principle and derive Lagrange's equations,
- apply the methods of the central force problem to Kepler motion,
- apply Euler's equations to a heavy symmetric top,
- analyse a system with small oscillations and derive normal coordinates as well as eigen frequencies,
- derive Hamilton's equations and the principle of least action.

Judgement and approach

Upon completion of the course, the student shall be able to:

- explain Hamilton's principle with or without constraints and the advantages with a variational principle,
- compare advantages of the Poisson bracket and Lagrange formulations.

Course content

The course contains the following:

- The variation principle and Lagrange's equations
- Hamilton's principle
- The central force problem with two bodies
- Motion of rigid bodies
- Small oscillations
- Lagrange formulation of special relativity
- Hamilton formalism
- Canonical transformations, the Hamilton-Jacobi equation and Poisson brackets
- Perturbation theory
- Continuous systems and fields

Course design

The teaching consists of lectures and exercise sessions.

Assessment

The examination consists of a number of written take home exams during the course and an oral exam at the end of the course. The student has to pass the take home exams before attempting the oral exam. Students who do not pass a regular exam are offered a new possibility shortly after the regular exam.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
To pass the entire course, it is required to pass both the oral exam as well as the take home exams. The final grade is based on the oral exam.

Entry requirements

For admission to the course, 75 credits in physics and 45 credits in mathematics is required including knowledge corresponding to FYTB14 Classical mechanics and special relativity, 7.5 credits.

Further information

The course cannot be counted towards a degree together with FYTN09.

Subcourses in FYTN16, Theoretical Physics: Classical Mechanics

Applies from H21

2101 Classical Mechanics, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction