Faculty of Science

FYTN13, Theoretical Physics: Symmetries and Group Theory, 7.5 credits

Teoretisk fysik: Symmetrier och gruppteori, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2016-05-15 and was last revised on 2016-05-15. The revised syllabus comes into effect 2016-05-15 and is valid from the spring semester 2017.

General information

The course is an elective course at second-cycle level for a degree of Master of Science (120 credits) in physics.

Language of instruction: English

Main field of study	*Specialisation*
Physics	A1F, Second cycle, has second-cycle course/s as entry requirements

Learning outcomes

The general the aim of the course is that the student should obtain knowledge of and understanding of the importance of symmetries in physics and how these can be described by means of group theory. In addition, on completion of the course the student shall be able to use group theory related tools and arguments to simplify calculations of physical problems.

Knowledge and understanding

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

- explain the basic concepts in abstract group theory and representation theory,
- describe the properties of the most common discrete and continuous groups such as the permutation group, the point group and the groups O(N), SO(N), U(N), SU(N) as well as the Lorentz group and the Poincaré group,

- describe applications of group theory in atomic and molecular physics, solid state physics and particle physics.

Competence and skills

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

- derive and apply essential theorems in group theory,
- analyse properties of symmetry related physical systems with group theory tools,
- use symmetries in physical problems to simplify calculations through the application of group theory.

Course content

- Definition of group and representation of group, irreducible representations.
- The permutation group and other discrete groups, discrete symmetries in physics such as point groups as well as their importance in solid state physics and atomic and molecular physics.
- Continuous groups (Lie groups), such as O(N), SO(N), U(N), SU(N) in particular SU(2), SU(3) and their importance in particle physics.
- Wigner-Eckart's theorem, Clebsch-Gordan coefficients and Young tableaux.
- Casimir operators, roots, weights and the Cartan subalgebra and classification of Lie algebras with finite dimension.
- The Lorentz group and the Poincaré group.
- Applications in atomic and molecular physics, solid state physics and particle physics.

Course design

The teaching consists of lectures and exercises.

Assessment

The examination takes place in the form of written hand-in assignments during the course as well as orally in the form of an exam at the end of the course.

Students who do not pass the regular exam are offered a new possibility shortly after the regular exam.

Grades

Grading scale includes the grades: Fail, Pass, Pass with distinction
To pass the whole course a passed exam and passed written assignments is required. The final grade is decided by the grade on the exam.

Entry requirements

For admission to the course, 90 credits in physics and 45 credits in mathematics is required, including knowledge equivalent to FYSN17 Quantum Mechanics, 7.5 credits, and MATB22 Linear algebra 2, 7.5 credits. English 6/English B.