FSI3120 Mathematical Foundations of Quantum Mechanics 7.5 credits

Kvantmekanikens matematiska grunder

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for FSI3120 valid from Spring 2009

Grading scale

Education cycle

Third cycle

Specific prerequisites

Advanced Quantum Mechanics.
Analysis, Basic Course.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completed course, the PhD student should be able to:

- know and use basic concepts in functional analysis.
- the fundamental postulates in quantum mechanics.
- derive Heisenberg's uncertainty principle.
- know and use basic concepts in group theory.
- apply Lie algebra and group theory in quantum mechanics.
- use the Wigner-Eckart theorem and compute Clebsch-Gordan coefficients.
- use approximation methods.
- have knowledge about the applications of quantum mechanics in physics.

Course contents

Basic functional analysis. Hilbert spaces. Banach spaces. Operator algebras. C* algebras. Spectral theory. The fundamental postulate in quantum mechanics. Heisenberg's uncertainty principle. Schrödinger operators. Unbounded operators. Introduction to symmetries and symmetry groups. Basic group theory. Permutation groups. Group representations and their properties. Lie algebras and Lie groups. The rotation and Lorentz groups. Tensor operators, the Wigner-Eckart theorem, and the Clebsch-Gordan series. Applications to physics (e.g., the hydrogen atom, elementary particles, many-particle systems, rigid bodies). The Hartree-Fock approximation. The semi-classical approximation.

Course literature

- **J. Mickelsson, Advanced Quantum Mechanics, edited by T. Ohlsson, KTH (2003)**
- **G. Lindblad, Symmetries in Physics - An Introduction to the Applications of Group Theory in Physics, KTH (2004)**

Examination

Based on recommendation from KTH’s coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

Hand in assignments and an oral exam.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.