# FSI3045 Advanced Quantum Mechanics 7.5 credits

## Kvantmekanik, fortsättningskurs

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 FSI3045 valid from Spring 2009

## Grading scale

## Education cycle

Third cycle

## Specific prerequisites

Mathematical Methods in Physics.
Quantum Physics.

## 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:

- apply Dirac's bracket notation.
- use Hermitian and non-Hermitian operators.
- know the path integral formalism of quantum theory.
- have knowledge about the matrix formulation of quantum mechanics and use density matrices.
- compute angular momentum and spin as well as have a good command of addition of angular momenta.
- use the variational principle and the WKB approximation.
- know the Aharonov-Bohm effect.
- have general knowledge about scattering theory as well as compute basic quantities in scattering theory.

## Course contents

Dirac's bracket notation. Hermitian and non-Hermitian operators. Wave packets. Path integral formulation of quantum theory. Matrix formulation. Density matrices. Many-body systems. Symmetries, rotational invariance, and angular momentum. The hydrogen atom. Spin. Addition of angular momenta. The variational principle and the WKB approximation. Time independent and time dependent perturbation theory. The Aharonov-Bohm effect. Introduction to scattering theory. Møller's wave operators. The Lippmann-Schwinger equation. Scattering matrices. The Born series and the Born approximation. Scattering amplitude, differential cross-section, and total cross-section. The optical theorem. Partial wave analysis. Long range potentials. The Rutherford formula. Resonances in scattering. Decay width and the Breit-Wigner formula.

## Course literature

**R. Shankar, Principles of Quantum Mechanics, Kluwer (1994)**

Other literature:

- **R.L. Liboff, Introductory Quantum Mechanics, Addison-Wesley (2003)**
- **J.J. Sakurai, Modern Quantum Mechanics, Addison-Wesley (1994)**

## 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

A written 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.