Quantum Mechanics

Programme course

6 credits

Kvantmekanik

TFFY54

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical Engineering, Physics and Mathematics

Date determined
2017-01-25

Main field of study
Applied Physics, Physics

Course level
Second cycle

Advancement level
A1X

Course offered for
- Physics and Nanoscience, Master's Programme
- Physics and Nanotechnology
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Materials Science and Nanotechnology, Master's programme

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Modern physics, linear algebra and fourier transform.

Intended learning outcomes
The purpose of the course is to give the student a deeper understanding of quantum mechanics and to further develop the students ability to solve quantum mechanical problems. Following the course, the student should be able to:
- derive results based on the postulates of quantum mechanics.
- use various representations of quantum mechanics.
- solve quantum mechanical problems that involve topics listed in the course content.

Course content

Historical background. Wave-particle dualism. Wave packets. The time-dependent Schrödinger equation. Probability current density. Expectation values. Hermitian operators. Time-independent Schrödinger equation.
Boundary conditions. Properties of eigenfunctions. General solution to the Schrödinger equation. Time evolution operator. The Dirac notation. State space. Adjoint operators. Unitary operators. Commutator.
Rigorous proof of the uncertainity principle. Heisenberg's matrix representation. Ehrenfest's theorem. The postulates of quantum mechanics.
Harmonic oscillator with operator method. Operators as generators of translation and rotation. Symmetries and conservation laws. Generalized angular momentum. Spherical harmonics. Pauli spin matrices. Spin dynamics.
Spherical symmetric potential. The hydrogen atom in magnetic fields. Spin-orbit term. Conceptual problems. Approximative methods: non-degenerate and degenerate perturbation theory; the variational method.

Teaching and working methods

The course is divided into lectures and lessons (problem solving sessions).

Examination

TEN1	Written examination	6 credits	U, 3, 4, 5

Grades

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

Other information

Supplementary courses: Quantum dynamics; Relativistic quantum mechanics; Elementary particle physics.

Department

Institutionen för fysik, kemi och biologi

Director of Studies or equivalent

Magnus Johansson

Examiner

Magnus Boman

Course website and other links

Education components

Preliminary scheduled hours: 62 h
Recommended self-study hours: 98 h

Course literature

B. H. Bransden and C. J. Joachain, Quantum Mechanics, second edition, Prentice Hall 2000.

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://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.