Quantum Dynamics

Programme course

6 credits

Kvantdynamik

TFYA28

Valid from: 2017 Spring semester

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

Date determined
2017-01-25

Replaced by
TFYT06

Main field of study
Applied Physics, Physics

Course level
Second cycle

Advancement level
A1X

Course offered for
- Physics and Nanoscience, Master's Programme
- 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
Quantum Mechanics, Modern physics

Intended learning outcomes
The main aim of the course is to give an exposition of the advanced concepts of quantum mechanics such as time-dependent perturbation theory, theory of many-particle systems, scattering theory, quantization of electromagnetic field and elements of relativistic quantum theory. After studying this course students should know:

- how to solve problems using such tools as state vectors and evolution operators, Schrödinger, Heisenberg and Dirac picture, non-pure states and density matrices
- the theory behind second quantization and some basic many-body systems
- the elements of scattering theory, quantization of electromagnetic field and relativistic quantum theory

Course content

Introduction and repetition. Wave packets. Group and phase velocity x-, p-, and N-representation. Change of bases. Closure. Spectral decomposition of operators. Unitary operators and trace. The evolution operator and its time-evolution. Schrödinger, Heisenberg and Dirac pictures. Time-dependent perturbation theory. Fermi's golden rule. Density operator. Pure and mixed states. Addition of angular momentum. Many particle systems. Hartree equations. Hartree-Fock equations. Density functional theory and the Kohn-Sham equations. Transport in two-dimensional semiconductor heterostructures. Second quantization or occupation number formalism. Tight-binding model and Hubbard model Scattering theory. Quantization of electromagnetic field. Interaction of matter with the light.Introduction to relativistic quantum mechanics. Klein-Gordon and Dirac equations. EPR-paradox and Bell's theorems.

Teaching and working methods

The course presented in the form of big seminars with theory and solution of problems

Examination

UPG1	Hand-in exercises and oral presentation	6 credits	U, 3, 4, 5

Grades

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

Other information

Supplementary courses: Relativistic Quantum Mechanics, Particle Physics

Department

Institutionen för fysik, kemi och biologi

Director of Studies or equivalent

Magnus Johansson

Examiner

Iryna Yakimenko

Course website and other links

http://www.ifm.liu.se/undergrad/fysikgtu/coursepage.html?selection=all&sort=kk

Education components

Preliminary scheduled hours: 64 h
Recommended self-study hours: 96 h

Course literature

Additional literature

Compendia

I.I. Yakymenko, Lecture Notes in Quantum Dynamics

Other

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.