Course syllabus

Kvantmekanik och matematiska metoder
Quantum Mechanics and Mathematical Methods

FMFF15, 7,5 credits, G2 (First Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED F/Pi
Date of Decision: 2023-04-18

General Information

Compulsory for: N4-nf
Elective for: E4, N4-hn
Language of instruction: The course will be given in English on demand

Aim

The student should after completing the course have a basic knowledge of quantum mechanics and mathematical methods of physics in order to continue studies in specializations towards nanophysics, highspeed- and nanoelectronics and photonics.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- be able to describe and apply the basic postulates of quantum mechanics.
- be able to see the usefulness of quantum theory in some applications.
- know the basics of mathematical methods in physics, especially with regard to applications in quantum physics.
- have applied knowledge of some special functions.

Competences and skills
For a passing grade the student must

- be able to solve and analyze quantum mechanical problems in the field of nanoscience.
- be able to carry out calculations in which the mathematical methods of physics are applied to problems from nanophysics.
- be able to apply the mathematical methods of the course for carrying out a computer project and analyze the results.

Contents

Quantum mechanics: Formalism of quantum mechanics: The Schrödinger equation as eigenvalue equation. Hermitian operators representing physical quantities, eigenvalues and eigenfunctions. The harmonic oscillator. Calculation Methodology: First order perturbation theory, variational methods and matrix diagonalization. Spherical coordinates and angular momentum. Applications to the hydrogen atom and atomic structure. Spin and magnetic interactions. Periodic potential. Bloch wave functions.
Mathematical Methods: Partial differential equations - classification and boundary conditions. General information on the eigenfunctions of operators. Bessel functions. Applications to cylindrical symmetry problems. Legendre polynomials. Spherical harmonic functions.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written exam, hand-ins, computer project.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Admission

Assumed prior knowledge: FAFA10 Quantum Phenomena and Nanotechnology, FMFF20 Mathematical Methods of Nanotechnology.
The number of participants is limited to: No
The course overlaps following course/s: FAF245, FAFF10, FMA021

Reading list

- Gunnar Ohlén: Kvantvärldens fenomen, chap. 5-8.
- Mathematics compendium.

Contact and other information

Course coordinator: Gillis Carlsson, gillis.carlsson@matfys.lth.se
Course homepage: http://www.matfys.lth.se/education/FMFF15