UNIVERSITY OF GOTHENBURG

PHYSICS

FYP203 Quantum physics A, 7.5 credits

Kvantfysik A, 7,5 högskolepoäng

First Cycle

Confirmation

This course syllabus was confirmed by Department of Physics on 2011-10-17 and was last revised on 2018-01-30 to be valid from 2018-01-30, spring semester of 2018.

Field of education: Science 100%
Department: Physics

Position in the educational system

The course is included in Physics and Medical Physics programs and is also given as a freestanding course.

The course can be part of the following programmes: 1) Bachelor of Science in Physics (N1FYS), 2) Medical Physicist Programme (N1SJU) and 3) Master's Programme in Chemistry (N2KEM)

Main field of studies	*Specialization*
Physics	G2F, First Cycle, has at least 60 credits in first-cycle course/s as entry requirements

Entry requirements

For admission to the course, completed courses are required from the three first semesters in the Physics program, or that the equivalent knowledge has been acquired in some other way. The course therefor assumes a familiarity with complex numbers, good knowledge of one variable calculus and also some knowledge of multi variable calculus. In addition good knowledge is needed of linear algebra and also classical mechanics and field theory.

Learning outcomes

On completion of the course, the student is expected to:

Knowledge and understanding

- have an understanding of the experimental results that contradicted classical physics and therefor led up to quantum physics
- have knowledge of the basic physical concepts and methods within quantum physics such as wave functions, the uncertainty principle and the superposition principle
- understand how the construction of the periodic table is explained on the basis of quantum physics

Competence and skills

- be able to explain why quantum physics is needed and what the difference is to classical physics
- be able to make simple calculations on quantum physical systems, e.g. wavelengths and energies
- be able to solve the Schrödinger equation in simple one-dimensional potential landscapes
- be able to describe energy level diagrams and how they relate to the spectral lines of an element
- be able to describe the dynamics for a two-level system on the Bloch sphere

Judgement and approach

- be familiar with how quantum physics has influenced our view of the world and on determinism
- be able to decide if a quantum physics description is essential or not for a specific problem

Course content

The course aims at giving the basic understanding of quantum physics, and also the mathematical tools for describing simple quantum mechanical systems.

The course includes the following:

- Experimental results that contradicted the classical physics and led to the development of the quantum theory;
- The wave nature of particles, the de Broglie wavelength, group velocity, phase velocity;
- The probability interpretation of the wave function and expectation values;
- Simple applications of the Schrödinger equation in one-dimensional potential landscapes: bound states, scattering;
- The operator formalism: Hermitian operators and how these describe measurments;

- The Schrödinger equation for central forces, angular momenum and spin, electronic states in one- and multi-electron atoms, the Pauli exclusion principle and the periodic table;
- Spin 1/2-system and its description on the Bloch sphere.

Form of teaching

Compulsory components with requirements of attendance: laboratory sessions (module 2)

Language of instruction: Swedish

Assessment

Part 1: written exam, 6.0 credits

Part 2: Project report, 1.5 credits

A student has the right to request a change of examiner if failed twice on the same exam, if this is practically possible. The application shall be sent to the board of the department and has to be in writing.

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).
For grade Pass of the whole course, Pass in all parts are required.

For grade Pass with distinction, Pass with distinction on module 1 is required and Pass on module 2. For each part applies:

Part 1: Written exam with grade Fail, Pass or Pass with Distinction.

Part 2: For grade Pass, approved project report is required.

Course evaluation

At the end of the course an anonymous course evaluation is provided. The result is published on the course homepage in University of Gothenburg's learning management system (GUL).