Quantum Mechanics II, 7.5 credits

Kvantmekanik II, 7.5 hp

Third-cycle education course

6FIFM47

Department of Physics, Chemistry and Biology

Valid from: First half-year 2024

Approved by **Approved**

Registration number

Entry requirements

Entry requirement for studies on third-cycle education courses

- second-cycle degree,
- 240 credits in required courses, including at least 60 second-cycle credits, or
- acquisition of equivalent knowledge in some other manner

Specific entry requirements for this course is the graduate course Quantum Mechanics I or the undergraduate course in quantum mechanics

Specific information

On the student’s request, course certificate is issued by the course examiner

Learning outcomes

By the end of the course the students will be able to:

- get knowledge about the methods of quantum statistics and density matrix
- get knowledge about scattering theory and time-dependent perturbation theory
- understand second quantization formalism for many-particle systems and quantization of electromagnetic fields
- get knowledge about main equations of relativistic quantum mechanics
- solve problems by using various quantum mechanical pictures for system evolution and density matrix for mixed states
- apply methods of scattering theory and time-dependent perturbation theory
- apply second quantization for many-particle systems and quantization of electromagnetic fields
- solve problems of relativistic quantum mechanics
- summarize, represent and discuss special topics of advanced quantum mechanics.

Contents

The course contains an exposition of the advanced concepts of quantum mechanics such as scattering theory, time-dependent perturbation theory, theory of many-particle systems, quantization of electromagnetic field and relativistic electron theory.
The course begins with the Green's function approach and Born approximation in the theory of scattering. The general principles of quantum dynamics are discussed with emphasis on the dynamics of a particle, including the Feynman's path integral formulation and density and its applications in the particular case of harmonic perturbation. Much attention will be paid to the time-dependent disturbance theory and its applications in the special case of harmonic disturbance.The creation and annihilation operators appear in the theory of the systems of identical particles, and the description of the many-body systems as the Thomas-Fermi, Hartree-Fock approximations and density-functional theory will be discussed. At the end of the course the quantization of electromagnetic field, interaction of light with matter and the elements of the relativistic electron theory will be considered.

Educational methods

The course contains lectures

Examination

Examination contains solution of the home assignments and oral presentation.

Grading

Two-grade scale

Course literature

E. Merzbacher. Quantum mechanics, 3rd edition, John Wiley and Sons, 1998.

General information

The course is planned and carried out according to what is stated in this syllabus. Course evaluation, analysis and suggestions for improvement should be fed back to the Research and PhD studies Committee (FUN) by the course coordinator.