



Faculty of Health, Science and Technology
Physics

Syllabus

Quantum Physics II

Course Code:	FYAD17
Course Title:	Quantum Physics II <i>Kvantfysik II</i>
Credits:	7.5
Degree Level:	Master's level
Progressive Specialisation:	Second cycle, has only first-cycle course/s as entry requirements (A1N)

Major Field of Study:
FYA (Physics)

Course Approval

The syllabus was approved by the Faculty of Health, Science and Technology 2024-01-31, and is valid from the Autumn semester 2024 at Karlstad University.

Prerequisites

45 ECTS credits in Physics, including Wave Physics and Optics, 7.5 ECTS credits, Introductory Modern Physics, 7.5 ECTS credits, Electromagnetic Field Theory, 7.5 ECTS credits, Quantum Physics I, 7.5 ECTS credits, and Solid State Physics, 7.5 ECTS credits, plus 30 ECTS credits in Mathematics, including Linear Algebra, 7.5 ECTS credits, Calculus in Several Variables, 7.5 ECTS credits, and Complex Analysis and Transforms, 7.5 ECTS credits, and upper secondary level English 6, or equivalent

Learning Outcomes

The aim of the course is for students to acquire in-depth knowledge and comprehension of quantum mechanics and its methods, and develop their skills in mathematical analysis of quantum mechanical systems.

Upon completion of the course, students should be able to:

- give an account of the most important approximation methods for both time-independent and time-dependent problems in quantum mechanics and their respective areas of validity, as well as demonstrate proficiency in their application,
- give an account of the dipole approximation and dipole active transitions,
- give an account of the quantum mechanical description of several- and many-particle systems and demonstrate proficiency in the computation of multi-electron atoms and simpler molecules,
- give an account of atomic and molecular orbitals and chemical bonds.
- give an account of and analyse the interaction of quantum physical systems with electromagnetic radiation and with external electric and magnetic fields,
- give an account of and be able to perform basic quantum mechanical computations with density operators,
- name and reflect on some central problems concerning the interpretation of quantum mechanics, and
- conduct basic spectroscopic experiments and analyse and interpret the obtained results.

Content

The harmonic and anharmonic oscillator and their applications. Several- and many-particle systems, especially fermionic systems. Approximation methods for time-independent and time-dependent systems. The interaction of quantum systems with electromagnetic radiation, selection rules, and the influence of external electric and magnetic fields. Atomic orbitals, including hybrid orbitals, molecular orbitals and covalent binding. Interpretation, quantum statistics, applications of quantum physics, and the measurement problem of quantum physics.

The course includes mandatory laboratory sessions on the spectroscopy of atoms, molecules, and solid materials.

Reading List

See separate document.

Examination

Assessment is based on a written exam, mandatory laboratory reports and hand-in assignments.

If students have a decision from Karlstad University entitling them to Targeted Study Support due to a documented disability, the examiner has the right to give such students an adapted examination or to examine them in a different manner.

Grades

One of the grades Fail (U), Pass (G), or Distinction (VG) is awarded in the examination of the course. For students in Engineering, one of the grades 5 (Pass with Distinction), 4 (Pass with Some Distinction), 3 (Pass), or U (Fail) is awarded in the examination of the course.

Quality Assurance

Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate

A course certificate will be provided upon request.

Additional information

The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.