Reg No: FYGC01/20192

Faculty of Health, Science and Technology
Physics

Syllabus

Quantum Physics II

Course Code:	FYGC01
Course Title:	Quantum Physics II *Kvantfysik II*
Credits:	7.5
Degree Level:	Undergraduate level
Progressive Specialisation:	First cycle, has at least 60 credits in first-cycle course/s as entry requirements (G2F)

Major Field of Study:
FYA (Physics)

Course Approval
The syllabus was approved by the Faculty of Health, Science and Technology 2019-02-26, and is valid from the Autumn semester 2019 at Karlstad University.

Prerequisites
45 ECTS credits in Physics, including Introductory Modern Physics 7.5 ECTS credits (or Matter 7.5 ECTS credits) and Quantum Physics I 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, or equivalent

Learning Outcomes
The aim of the course is that the students acquire advanced knowledge and comprehension of quantum mechanics and its methods, and develop their skills in mathematically analysing 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 the central concepts of statistical quantum mechanics 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 oscillator and applications, step operators. Several- and many-particle systems, especially fermionic systems. Time-independent and time-dependent perturbation theory and selection rules. The interaction of quantum systems with electromagnetic radiation as well as with external electric and magnetic fields. Atomic and molecular orbitals, chemical binding. Quantum statistics, applications of quantum physics, and the measurement problem of quantum physics. Laboratory assignments in 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.

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

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.