Department of Physics

Stockholm University

# Syllabus

for course at first level

**Quantum Mechanics, distance learning**
**Kvantmekanik, distans**

**7.5 Higher Education Credits**
**7.5 ECTS credits**

| | |
|---|---|
| **Course code:** | FK5033 |
| **Valid from:** | Summer 2022 |
| **Date of approval:** | 2022-02-02 |
| **Department** | Department of Physics |
| **Main field:** | Physics |
| **Specialisation:** | G2F - First cycle, has at least 60 credits in first-cycle course/s as entry requirements |

## Decision

This course syllabus was approved by the Board of Science at Stockholm University on 02/02/2022.

## Prerequisites and special admittance requirements

For admission to the course, knowledge is required equivalent to
• Mathematics for the Natural Sciences I, 15 credits (MM2002)
• Mathematics for Natural Sciences II, 15 credits (MM4001)
• Mathematics II - Linear Algebra, 7.5 credits (MM5012)
• Classical Physics, 30 credits (FK3014)
• Programming, Numerical Methods and Statistics for Physicists, 15 credits (FK4026) or the two courses Physics with Digital Tools, 7.5 credits (FK4025) and Probability and Statistics for Teachers, 7.5 credits (MT1011)
• Electromagnetism and Waves, 7.5 credits (FK5019)

## Course structure

| Examination code | Name | Higher Education Credits |
|---|---|---|
| HELA | Quantum Mechanics | 7.5 |

## Course content

This course addresses:Historical background to quantum physics. Basic concepts and methods in non-relativistic quantum mechanics: wave function and its interpretation; Schrödinger equation; the uncertainty principle; operators; one-dimensional potentials; free particles; harmonic oscillator and step operators; The Schrödinger equation in three dimensions; hydrogen atoms; angular momentum, spin, two-level system and addition of angular momenta.

## Learning outcomes

After completing the course, the student is expected to be able to:
• account for the historical background of quantum mechanics
• account for basic concepts in non-relativistic quantum mechanics
• master methods for solving the Schrödinger equation in one dimension
• master methods for solutions to the Schrödinger equation in three dimensions with central potential, especially the hydrogen atom
• treat mathematical formalism and spin and apply it to quantum mechanical systems

• apply formalism for two-level systems.

### Education
Teaching consists of lectures and problem solving sessions. Teaching is provided as distance education. The course is offered in English.

### Forms of examination
a. The course is examined as follows: Assessment takes place through written exam and written and oral reports of hand-in exercises.

The examination will be conducted in English.

The examiner can decide on adapted or alternative examination formats for students with disabilities.

b. The course has no compulsory instruction.

Participation in the written examination requires attendance on campus.

c. Grading: The course's final grade is set according to a seven-point criterion-referenced scale:
A = Excellent
B = Very good
C = Good
D = Satisfactory
E = Adequate
Fx = Failed, some additional work is required
F = Failed, much additional work is required.

d. The course's grading criteria are handed out at the start of the course.

e. Students who receive a failing grade on a regular examination are allowed to retake the examination as long as the course is still provided. The number of examination opportunities is not limited. Other mandatory course elements are equated with examinations. A student who has received a passing grade on an examination may not retake the examination to attain a higher grade. A student who has failed the same examination twice is entitled to have another examiner appointed, unless there are special reasons to the contrary. Such requests should be made to the department board. The course includes at least three examination opportunities per academic year the course is offered. For the academic years that the course is not offered, at least one examination opportunity is offered.

f. Students awarded the grade Fx are given the opportunity to improve their grade to E. The examiner decides on the supplementary assignments to be performed and the pass mark criteria. The supplementary assignments will take place before the next examination opportunity.

### Interim
Students may request that the examination be conducted in accordance with this course plan even after it has ceased to be valid. However, this may not take place more than three times over a two-year period after the course was discontinued. Requests must be made to the departmental board. The provision also applies in the case of revisions of the course syllabus and revisions of the required reading.

### Limitations
The course may not be included as a part of a degree together with the courses Quantum Mechanics I, 7.5 credits (FK5011) or Quantum Mechanics, 7.5 credits (FK5020).

### Misc
This course is offered as a separate course. Courses offered as a distance course require access to a computer, webcam, headphones, microphone and internet.

### Required reading
The required reading is decided by the department board and published on the course page in the digital course catalog at least 2 months before the start of the course.