GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2025-2026

Quantum Mechanics 2 (C002245)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2025-2026

A (semester 1)	Dutch	Gent	lecture
			seminar

Lecturers in academic year 2025-2026

Bultinck, Nick	WE05	lecturer-in-charge
Van Neck, Dimitri	WE05	co-lecturer

Offered in the following programmes in 2025-2026	crdts	offering
Bachelor of Science in Mathematics	6	A
Bachelor of Science in Physics and Astronomy	6	A
Preparatory Course Master of Science in Physics and Astronomy	6	A
Preparatory Course Master of Science in Physics and Astronomy	6	A

Teaching languages

Dutch

Keywords

Quantum mechanics Theoretical Physics

Position of the course

This course unit belongs to the learning pathway "Theoretical physics" in the Bachelor program Physics and Astronomy.
To familiarize the students with the concepts, laws and ways of thinking of chemical thermodynamics and with the applications to phase transitions and chemical reactions. To provide insight into the molecular background of thermodynamic concepts. To discuss the various aspects of the problem of reaction rate. To demonstrate how rate equations are deduced from experimental data and how rate equations and reaction mechanisms are related. To explain and evaluate the theories on reaction rates which are currently used.

Contents

- Spherical harmonics and the hydrogen atom.
- Axiomatic approach to quantum mechanics using electron spin.
- The measurement problem and entanglement.
- Quantum computing.
- Symmetry in quantum mechanics: translation and rotation symmetry.
- The three dimensional Schrödinger equation: central potential and particle in an electromagnetic field.
- Scattering theory and partial wave analysis of potential scattering.
- Approximation methods in quantum mechanics: time independent and time dependent perturbation theory (interaction picture), and variational methods.
- Introduction to relativistic quantum mechanics: Klein Gordon - and Dirac equations, Lorentz invariance, spinors.
- Free relativistic particle.
- Interacting many-particle systems and second quantisation.

Initial competences

Basic knowledge of mathematical analysis and linear algebra is sufficient.

Final competences

1 The student can apply advanced mathematical methods to other areas, in particular to quantum mechanical problems.
2 The student has a thorough understanding of the mathematical and physical principles of quantum mechanics.
3 The student can communicate this insight in a structured way and has a critical and scientific attitude towards the insights that the student has gained.
4 The student can apply this insight and the knowledge when analysing and solving problems.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture

Study material

Type: Syllabus

Name: Syllabus
Indicative price: € 5
Optional: no
Additional information: available through Ufora

Type: Slides

Name: Lectures slides
Indicative price: € 5
Optional: no
Additional information: available through Ufora

References

- J. J. Sakurai: *Modern Quantum Mechanics*
- B. H. Bransden & C. J. Joachain: *Quantum Mechanics*
- J. Björken & S. Drell : *Relativistic Quantum Mechanics*, McGraw-Hill (1964)
- L. Landau & E. Lifschitz : *Quantum Mechanics*,Pergamon (1965)
- A. Messiah : *Mécanique Quantique*, Dunod (1960)

Course content-related study coaching

There is possibility for consulting the teacher and assisting personel.

Assessment moments

end-of-term assessment

Examination methods in case of periodic assessment during the first examination period

Oral assessment, Written assessment

Examination methods in case of periodic assessment during the second examination period

Oral assessment, Written assessment

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

Theory : written and oral evaluation (with written preparation), closed book
Exercises : written evaluation, open book

Calculation of the examination mark

50% (theory)+ 50% (exercises)