# UE Quantum Physics I

Niveau d'étude
Bac +4

ECTS
3 crédits

Composante
UFR Physique, Ingénierie, Terre, Environnement, Mécanique (PhITEM)

Période de l'année
Automne (sept. à dec./janv.)

## Diplômes intégrant cet élément

- Master Nanosciences et nanotechnologies

**Langue(s) d'enseignement:** Anglais

**Ouvert aux étudiants en échange:** Oui

**Code d'export Apogée:** PAX7NQAB

# Présentation

## Description

*Goal*: This course is a deepening of the quantum mechanics concepts introduced in the undergraduate courses. The fundamental principle of quantum mechanics are illustrated by applications to nanoscale condensed-matter systems taken from recent research works and by discussing prospects for quantum information technologies. The concepts presented in this course are prerequisites for many second-year courses related to nanophysics and quantum engineering. A good knowledge in quantum mechanics is indeed more and more essential for technological research and development of nanoscale quantum devices.

*Content*

- **Chapter 1**: Introduction and recalls on the quantum mechanics postulates and formalism (Dirac notation, Hilbert space). Two-level system, Zeeman effect, spin Hamiltonian. Tensorial product notation for states and operators. Many-body quantum states (bosons and fermions).
  Exercices: Basics of quantum mechanics formalism.
- **Chapter 2**: Recalls on confinement problem. Electron bound states in a potential.



Informations non contractuelles.
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Exercises: Example of 1D confinement problems, quantum harmonic oscillator.

- **Chapter 3**: Introduction to atomic physics. Spherical symmetry, angular and spin kinetic momenta. Mean field approximation, central potential, many electrons atoms, Hund rules, spin-orbit coupling, optical transitions.
  Exercises: Grotrian diagrams, spin-orbit coupling, fine and hyperfine structure.
- **Chapter 4**: Approximation methods for eigenstate calculations, perturbation theory, variational method.
  Exercises: Application to electronic systems.
- **Chapter 5**: Time evolution. General equation for the time evolution, two-level systems, perturbation theory, Fermi golden rules.
  Exercises: Application to Rabi oscillations.

*Prerequisites*: Basics of quantum mechanics.

*Bibliography*: Quantum mechanics, C. Cohen-Tannoudji, Vol. 1, ISBN-13: 978-0471164333, Vol. 2, ISBN-13: 978-0471569527.

## Heures d'enseignement

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|---|---|---|
| CMTD | Cours magistral - Travaux dirigés | 24h |

**Période :** Semestre 7

# Infos pratiques

## Campus

Grenoble - Domaine universitaire



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