



# UNIVERSITÀ DI PISA

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## QUANTUM PHYSICS OF MATTER

**GIUSEPPE CARLO LA ROCCA**

Anno accademico  
CdS

2023/24  
MATERIALS AND  
NANOTECHNOLOGY

Codice  
CFU

397BB  
6

Moduli	Settore/i	Tipo	Ore	Docente/i
QUANTUM PHYSICS OF MATTER	FIS/03	LEZIONI	48	GIUSEPPE CARLO LA ROCCA STEFANO LUIN

### Obiettivi di apprendimento

#### *Conoscenze*

Become familiar with the basic concepts of quantum mechanics and learn how to make use of the Schroedinger equation. Use these tools for an elementary microscopic description of the properties of atoms and molecules.

*Modalità di verifica delle conoscenze*  
exam

#### *Capacità*

basic understanding and elementary working knowledge

*Modalità di verifica delle capacità*  
exam

#### *Comportamenti*

motivation, attention, commitment

*Modalità di verifica dei comportamenti*  
participation to classes, exam

#### Prerequisiti (conoscenze iniziali)

General physics and calculus.

#### Programma (contenuti dell'insegnamento)

##### *1. Introduction to quantum mechanics*

Waves and particles. Wave-particle duality and uncertainty principle. Wave function. Schroedinger equation and stationary states. Expectation values. Examples: potential well and harmonic oscillator. Transition probability and selection rules.

##### *2. Atomic physics*

First atomic models and their shortcomings. Hydrogen atom: energy spectrum, angular momentum and eigenfunctions. Electron spin. Pauli exclusion principle. Helium atom, singlet and triplet states. Many-electron atoms, periodic system of elements. Atomic spectroscopy.

##### *3. Molecular physics*

The ionized hydrogen molecule. The hydrogen molecule. Homonuclear and heteronuclear diatomic molecules. Polyatomic molecules. Molecular vibrations. Molecular Spectroscopy.

#### Bibliografia e materiale didattico

hand-out notes



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Alonso-Finn: "Fundamental university physics, vol. 3: quantum and statistical physics"  
Landshoff-Metherell-Rees: "Essential Quantum Physics", Cambridge

### Indicazioni per non frequentanti

please contact: [giuseppe.larocca@sns.it](mailto:giuseppe.larocca@sns.it)

### Modalità d'esame

oral exam (written exam upon request)

*Ultimo aggiornamento 25/10/2023 16:19*