

## DIM-SAP-232 Quantum Physics

**SEMESTER:** Spring  
**CREDITS:** 3 ECTS (2 hrs. per week)  
**LANGUAGE:** English  
**DEGREES:** SAPIENS program

### Course overview

This course is aimed to introduce basic concepts and ideas on Quantum Mechanics. The lectures will focus on essential physical principles supported by mathematical developments when required. Every idea will be also illustrated with some technological application. The students will participate actively in the discussions and the course its aimed to combine work outside the class (pre-lectures and homework) as well as active discussions and peer instruction during class time.

### Prerequisites

Students are expected to have a good understanding of:

- classical mechanics
- electric potential (Coulomb's Law, electric fields, Gauss' Law, electric potential, capacitance, circuits, magnetic forces and fields, Ampere's law, induction, electromagnetic waves)
- ray optics (polarization, geometrical optics)

and to:

- be familiar with curve sketching, exponential and trigonometric functions.
- be able to differentiate and integrate simple functions
- be familiar with partial derivatives and basic complex number algebra

### Course contents

1. Photons. Light waves behaving as particles. Light Absorbed as Photons: The Photoelectric Effect. Light Emitted as Photons: X-Ray Production. Light Scattered as Photons: Compton Scattering and Pair Production. Wave-Particle Duality, Probability, and Uncertainty.
2. Particles Behaving as Waves. Electron Waves. The Nuclear Atom and Atomic Spectra. Energy Levels and the Bohr Model of the Atom. The Laser. Continuous Spectra. The Uncertainty Principle Revisited.

3. Quantum Mechanics. Wave Functions and the One-Dimensional. Schrödinger Equation. Particle in a Box. Potential Wells. Potential Barriers and Tunneling. The Harmonic Oscillator.
4. Atomic Structure. The Schrödinger Equation in three Dimensions. Particle in a Three-Dimensional Box. The Hydrogen Atom. Electron Spin. Many-Electron Atoms and the Exclusion Principle.
5. A Brief Introduction to Molecules and Condensed Matter. Types of Molecular Bonds. Structure of Solids and Energy Bands. Semiconductors and Superconductivity.

## Textbook

- Young, H.D., Freedman, R.A. (2012). *University Physics, Volume 3 (Chs. 37-44)*. 13th Edition. Pearson
- Longair, M.S. (2003). *Theoretical Concepts in Physics: An Alternative View of Theoretical Reasoning in Physics*. 2<sup>nd</sup> Edition. Cambridge University Press.

## Grading

The grade will be determined by pre-lectures (10%), one midterm (30%), homework (20%), and a final examination (40%). The exams are all closed notebook, closed textbook and no calculator. The course will not be graded on a curve, i.e., there is no bound on the numbers of A's, B's, C's etc.