YACHAY TECH UNIVERSITY

COURSE PROGRAM

1. General Information

A.	**SCHOOL**	Physical Sciences and Nananotechnology			**B.**	**MAJOR**	Physics Nanotechnology
C.	**COURSE**	Quantum Mechanics I			**D.**	**CODE**	PHYS602
E.	**CURRICULAR UNIT**	Professional			**F.**	**MODALITY**	Face to face
G.	**TOTAL HOURS**	64 [1]	48 [2]	88 [3]	**H.**	**SEMESTER**	6th

2. Prerequisites and Corequisites

PREREQUISITES		COREQUISITES	
COURSES	**Code**	**COURSES**	**Code**
Modern Physics	PHYS502		
Classical Mechanics	PHYS503		
Oscillations, electricity and magnetism	PHYS501		
Mathematical Physics I	PHYS504		

3. Course Description

This course provides an introduction to the formal mathematical treatment of Quantum Mechanics. The course introduces the Schrödinger Equation and its solutions for different potentials, emphasising on its statistical interpretation and its importance for the description of experiments at quantum scales. Topics range from wave functions, the time-independent Schrödinger's equation, through Hilbert spaces and the mathematical formalism of quantum mechanics, to the description of the hydrogen atom and two-particle systems. The course includes examples of different applications of quantum mechanics, including writing Hamiltonians for different physical systems and extracting information about them.

4. Course Contribution to professional training

The course helps students to develop the mathematical skills needed to create realistic models of quantum systems.

[1] Teaching Hours. For courses with NON-VALID curriculums, take into account the total number of hours of each course found in each curriculum and place it in this space.

[2] Hours of Internship and Experimental Learning

[3] Hours of Independent Learning

5. Course objectives

- Understand the fundamental ideas and experiments that led to the formulation of quantum mechanics.
- Learn the mathematical skills and formalism needed to solve Schrödinger's equation and interpret its solutions.
- Study the Hamiltonians of quantum systems in 1D and 3D for different potentials and coordinates, and provide a detailed quantum description of the hydrogen atom.
- Use quantum mechanics to analyse real microscopic phenomena and interpret experimental data.

6. Units / Contents

CURRICULAR UNITS	CONTENTS
UC.1 The Schrödinger equation	Review of quantum experiments and mathematical tools.
	The wave function and the Schrödinger equation.
	Statistical interpretation of the wave function and probability.
	Normalisation, momentum, and the uncertainty principle.
UC.2 Quantum Mechanics in 1D	Stationary states and the time-independent Schrödinger equation.
	Free particles and wave packets.
	Finite, Infinite potential wells, and the harmonic oscillator.
	Delta-function potentials, tunnelling and scattering states.
UC.3 Mathematical formalism of Quantum Mechanics	Linear algebra, Hermitian operators, and Hilbert space
	Eigenfunctions, eigenvectors, and eigenvalues for discrete and continuous spectra.
	Dirac notation and the Generalised statistical interpretation
	Operators of position and momentum and the uncertainty principle
UC.4 Quantum Mechanics in 3D	Schrodinger Equations in Spherical Coordinates
	Coulomb potential and quantum description of the Hydrogen atom
	Angular momentum and spin
	Larmor precession and the Stern- Gerlach experiment
UC.5 Two-Particle Systems and quantum applications	Identical particles and introduction to two-particle systems.
	Exchange interactions, spin, and the generalised symmetrisation principle
	Atoms, the periodic table, and introduction to solids
	Applications of quantum mechanics

7. Learning outcomes of the course	
A.	Understand the fundamental ideas and experiments that led to the formulation of quantum mechanics.
B.	Learn the mathematical skills and formalism needed to solve Schrödinger's equation and interpret its solutions.
C.	Study the Hamiltonians of quantum systems in 1D and 3D for different potentials and coordinates, and provide a detailed quantum description of the hydrogen atom.
D.	Use quantum mechanics to analyse real microscopic phenomena and interpret experimental data.

8. Methodology

1. Interactive lectures including theory and exercises.
2. Classwork including exercises and quizzes based on reading material and online laboratory applets.
3. Individual and group projects including problem sets and bibliographic research.

9. Information Sources (Bibliography)

9.1 Main

Author/s	Title of Work	Edition	Year of Publication	Publishing house - Country	Availability at YACHAY TECH Library
Griffiths, David	Introduction to Quantum Mechanics	2nd	2017	Cambridge University Press – United States	530.12 G8553i 2017

9.2 Complementary

Author/s	Title of Work	Edition	Year of Publication	Publishing house - Country	Availability at YACHAY TECH Library
Townsend, John	A Modern Approach to Quantum Mechanics	2nd	2012	University Science Books – United States	530.12 T748m 2012
Tong, David	Lectures on Quantum Mechanics	--	2021	http://www.damtp.cam.ac.uk/user/tong/quantum.html	Online

10. Student's Evaluation

Midterm Exam (MT)	☑	Formative Evaluation (FO)	☑	Laboratory (LAB)	☑	Final Exam (FI)	☑

Based on the Academic Regime Regulation issued by the Higher Education Council (CES in Spanish) and the Academic Regime Regulation of Yachay Tech
The inputs that contribute to the completion of this format must be taken from the major project approved by CES.

Prepared by:	Reviewed by:	Approved by:
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SIGNATURE AND DATE:	**SIGNATURE AND DATE:**	**SIGNATURE AND DATE:**