

# PHY3251: QUANTUM MECHANICS

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## Effective Term

Semester A 2025/26

## Part I Course Overview

### Course Title

Quantum Mechanics

### Subject Code

PHY - Physics

### Course Number

3251

### Academic Unit

Physics (PHY)

### College/School

College of Science (SI)

### Course Duration

One Semester

### Credit Units

3

### Level

B1, B2, B3, B4 - Bachelor's Degree

### Medium of Instruction

English

### Medium of Assessment

English

### Prerequisites

- (1) AP3202/PHY3202 Modern Physics
- (2) MA2158 Linear Algebra and Calculus (or equivalent)\*

### Precursors

Nil

### Equivalent Courses

AP3251 Quantum Physics

### Exclusive Courses

Nil

### Additional Information

\* This pre-requisite requirement (MA2158) is waived for Advanced Standing I students and Advanced Standing II students.

## Part II Course Details

### Abstract

To provide a fundamental understanding to the principles of modern physics. To lay the foundation for advanced courses such as solid-state physics. To introduce applications in semiconductor physics and electronic devices.

### Course Intended Learning Outcomes (CILOs)

CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Establish the concept of the wave-particle duality of matter.	10	x	
2	Understand quantum state, wavefunction and its probability interpretation.	15	x	
3	Apply the Schrödinger equation to solve various problems: 1D quantum well, 1D potential barrier tunneling, 1D harmonic oscillator.	15		x
4	Apply the Schrödinger equation to solve 3D physical system: the hydrogen atom.	10		x
5	Understand quantized orbital angular momentum and spin angular momentum of electrons.	15		x
6	Understand the fine structure of the hydrogen atom.	10		x
7	Obtaining brief knowledge of identical particles.	10		x
8	Understand time-independent perturbation theory	15		x

#### A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

#### A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

#### A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

### Learning and Teaching Activities (LTAs)

LTAs	Brief Description	CILO No.	Hours/week (if applicable)	
1	Lectures	Present basic theories, concepts and examples	1, 2, 3, 4, 5, 6, 7	2 hours/week
2	Tutorials	Provide additional explanations and help the students to practice what they learn in the lectures	1, 2, 3, 4, 5, 6, 7	1 hour/week

### Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("- " for nil entry)	Allow Use of GenAI?
1	Assignments	1, 2, 3, 4, 5, 6, 7	20	-	Yes
2	Quizzes	1, 2, 3, 4, 5, 6, 7	20	-	No

**Continuous Assessment (%)**

40

**Examination (%)**

60

**Examination Duration (Hours)**

2

**Minimum Examination Passing Requirement (%)**

30

**Additional Information for ATs**

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained

**Assessment Rubrics (AR)****Assessment Task**

1. Assignments

**Criterion**

The student completes all assessment tasks/activities and the work demonstrates excellent understanding of the scientific principles and the working mechanisms.

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not reaching marginal level

**Assessment Task**

2. Quizzes

**Criterion**

The student can thoroughly identify and explain how the principles are applied to science and technology for solving physics and engineering problems.

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not reaching marginal level

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**Assessment Task**

3. Examination

**Criterion**

The student can thoroughly identify and explain how the principles are applied to science and technology for solving physics and engineering problems.

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not reaching marginal level

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## Part III Other Information

**Keyword Syllabus**

- The Stern-Gerlach Experiment.
- The Schrödinger Equation.
- The Infinite Square Well.
- The Harmonic Oscillator
- The Delta-Function Potential and Finite Square Well.
- Mathematical Foundations of Quantum Mechanics.
- Matrix Mechanics and Dirac Notation.
- Schrödinger Equation in 3D Systems.
- The Hydrogen Atom.
- Angular Momentum (orbital and spin); Angular Momentum Additions.
- Time-independent Perturbation Theory (non-degenerate and degenerate).
- Identical Particles.

**Reading List****Compulsory Readings**

Title	
1	David J. Griffiths, Introduction to Quantum Mechanics, Cambridge University Press; 3rd edition (August 16, 2018).

**Additional Readings**

Title	
1	J. J. Sakurai, Modern Quantum Mechanics, Cambridge University Press; 2nd edition (September 22, 2017).
2	R. Shankar, Principles of Quantum Mechanics, Plenum Press; 2nd edition (March 16, 2011).
3	Richard L. Liboff, Introductory Quantum Mechanics, Addison-Wesley; 4th edition (August 18, 2002).
4	The Feynman Lectures on Physics, Vol. III.