

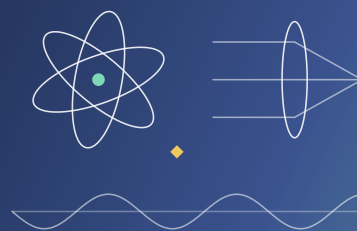
Module code

**SPP-2202**

Type of module

**Undergraduate: Applied Physics – Major Core**

# Quantum Mechanics and Atomic Physics



Modular credits

**4**

Total student  
engagement

**56** hours

Prerequisite

**None**

Anti-requisite

**None**

## Aims

To introduce the core principles of quantum mechanics and apply them to atomic structure and spectra.

## Module learning outcomes (MLO)

*On successful completion of this module, a student will be expected to be able to:*

### MLO 1

Apply and analyse mathematical methods underlying core quantum mechanical concepts.

### MLO 2

Analyse and apply the concept of spin, spin angular momentum, its orientations, and the Pauli exclusion principle.

### MLO 3

Apply quantum mechanical operators to analyse the quantisation of energy, barrier penetration, and alpha-particle emission in radioactive nuclei.

### MLO 4

Use quantum mechanical methods to model and interpret physical phenomena in systems including atoms, nuclei, molecules, and solids.

### MLO 5

Analyse and interpret atomic spectra using selection rules, the Zeeman effect, and X-ray spectra to explain electronic structure and transitions.

## Module contents

Fundamentals of quantum mechanics: operators, uncertainty principle, Schrödinger equation

Quantum states: stationary states, eigenvalues/eigenfunctions, and bound states

Model systems: infinite square well, potential step, free particle, harmonic oscillator

Hydrogen atom: Schrödinger equation solutions, quantum numbers, probability density

Atomic structure: selection rules, Zeeman effect, electron spin, angular momentum

Applications: periodic table, electronic configurations, spin-orbit coupling, X-ray spectra

## Assessment

60%

Examination

40%

Coursework



■ Examination — 60% ■ Weekly assignments — 20% ■ Tests — 10% ■ Oral presentation — 10%

### Formative assessment

Weekly discussion, quizzes, and feedback

### Summative assessment

| COMPONENT          | WEIGHTING |
|--------------------|-----------|
| Examination        | 60%       |
| Coursework         | 40%       |
| Individual         | 30%       |
| Weekly assignments | 20%       |
| Tests              | 10%       |
| Group              | 10%       |
| Oral presentation  | 10%       |

## Graduate attributes and skills

### Programme learning objectives (PLO) addressed

1

PLO 1 (Core Disciplinary Knowledge)

2

PLO 2 (Critical Thinking and Comparative Analysis)

4

PLO 4 (Numerical and Analytical Competence)

### Sustainability concept addressed

4

SDG 4 Quality Education

9

SDG 9 Industry, Innovation, and Infrastructure

### Digital skills/software used (not limited to)

- Word processing software (e.g. Microsoft Word)
- Presentation software (Microsoft PowerPoint)
- Web browsers (e.g. Internet Explorer)
- Learning Management Systems (e.g. Canvas)

Micro-credentialling option

No

Stackable towards GenBESTARI Undergraduate Degree Programme or other relevant Lifelong Learning Programmes

No

### Document details

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