



UNSW Course Outline

PHYS2111 Quantum Physics - 2024

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General Course Information

Course Code : PHYS2111

Year : 2024

Term : Term 1

Teaching Period : T1

Is a multi-term course? : No

Faculty : Faculty of Science

Academic Unit : School of Physics

Delivery Mode : In Person

Delivery Format : Standard

Delivery Location : Kensington

Campus : Sydney

Study Level : Undergraduate

Units of Credit : 6

Useful Links

[Handbook Class Timetable](#)

Course Details & Outcomes

Course Description

Quantum mechanics addresses the interesting wave-like quantised physical phenomena that occur at microscopic scales. The subject was a major research focus of the 'modern physics' revolution of the 1900s and is shaping as a key technology driver of the early 2000s. This first course in quantum mechanics provides students with a broad and comprehensive introduction

to the technical fundamentals of quantum mechanics and builds a strong foundation for further studies. Topics covered include:

Angular momentum in classical and quantum limits. Quantum spin (two-level systems). Vector representation and Hilbert spaces. Bras & kets and matrix formulation of quantum mechanics. Operators. Eigenvalues and Eigenvectors. Expectation value. Pauli matrices. Classical and quantum correlation. Entanglement. Infinite state limit and wavefunctions as states. Simultaneous observables. Commutators. Statistics of uncertainty. Uncertainty principle as a generalised concept. Developments leading up to the wave equation. Schrodinger's equation. Wavefunctions and expectation values. Infinite and finite square potential well. Quantum harmonic oscillator. Time evolution and coherence. Fourier's theorems and Fourier transforms. Quantum propagation of a free particle. Barriers and steps. Delta function and periodic potentials.

Course Aims

This first course in quantum mechanics provides students with a broad and comprehensive introduction to the technical fundamentals of quantum mechanics and builds a strong foundation for further studies.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Explain the core principles of quantum mechanics and the basis of many of the unique behaviours and properties found in quantum mechanical systems, e.g., interference, uncertainty, entanglement.
CLO2 : Apply the associated mathematical frameworks to analyse a variety of basic problems related to two-level quantum systems using the Heisenberg matrix mechanics formalism.
CLO3 : Apply the associated mathematical frameworks to analyse a variety of basic problems related to quantum systems from the perspective of Schrödinger wave-mechanics formalism.
CLO4 : Acquire and interpret experimental data for laboratory experiments related to basic quantum mechanical phenomena.

Course Learning Outcomes	Assessment Item
CLO1 : Explain the core principles of quantum mechanics and the basis of many of the unique behaviours and properties found in quantum mechanical systems, e.g., interference, uncertainty, entanglement.	<ul style="list-style-type: none">• Quizzes/Assignments• Final exam
CLO2 : Apply the associated mathematical frameworks to analyse a variety of basic problems related to two-level quantum systems using the Heisenberg matrix mechanics formalism.	<ul style="list-style-type: none">• Quizzes/Assignments• Final exam
CLO3 : Apply the associated mathematical frameworks to analyse a variety of basic problems related to quantum systems from the perspective of Schrödinger wave-mechanics formalism.	<ul style="list-style-type: none">• Quizzes/Assignments• Final exam
CLO4 : Acquire and interpret experimental data for laboratory experiments related to basic quantum mechanical phenomena.	<ul style="list-style-type: none">• Laboratory

Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams

Learning and Teaching in this course

See Moodle for more details on how course will run in a given year.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Laboratory Assessment Format: Individual	20%	
Quizzes/Assignments Assessment Format: Individual	20%	
Final exam Assessment Format: Individual	60%	

Assessment Details

Laboratory

Assessment Overview

Student will complete several three-hour laboratory sessions over the term, the first one to be scheduled within the first three weeks of the term. Assessments will be based on the written account and accompanying interview with an academic marker after the experiment. Marks will be allocated based on (i) an understanding of the underlying physical principles and (ii) the quality of the experimental results and analysis. Feedback is provided on the same day as the interview.

Course Learning Outcomes

- CL04 : Acquire and interpret experimental data for laboratory experiments related to basic quantum mechanical phenomena.

Quizzes/Assignments

Assessment Overview

This will be continuous assessment throughout the term focused on the development of problem solving skills related to the various aspects of the course learnt in each week. This will typically involve 1-2 exam-style problems a week with general feedback provided during the tutorial classes.

Course Learning Outcomes

- CL01 : Explain the core principles of quantum mechanics and the basis of many of the unique behaviours and properties found in quantum mechanical systems, e.g., interference, uncertainty, entanglement.
- CL02 : Apply the associated mathematical frameworks to analyse a variety of basic problems related to two-level quantum systems using the Heisenberg matrix mechanics formalism.

- CL03 : Apply the associated mathematical frameworks to analyse a variety of basic problems related to quantum systems from the perspective of Schrödinger wave-mechanics formalism.

Final exam

Assessment Overview

Students will sit a 2-hour written final exam during the exam period.

The final course mark will be given to student.

Course Learning Outcomes

- CL01 : Explain the core principles of quantum mechanics and the basis of many of the unique behaviours and properties found in quantum mechanical systems, e.g., interference, uncertainty, entanglement.
- CL02 : Apply the associated mathematical frameworks to analyse a variety of basic problems related to two-level quantum systems using the Heisenberg matrix mechanics formalism.
- CL03 : Apply the associated mathematical frameworks to analyse a variety of basic problems related to quantum systems from the perspective of Schrödinger wave-mechanics formalism.

General Assessment Information

Please note that the marks in Moodle are raw marks and may be subjected to moderation in order to calculate your final mark.

Grading Basis

Standard

Course Schedule

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

The expected progression through content in the course is as follows.

Week 1: Quantum measurement, Hilbert space, Projections

Week 2: Operators, Fundamental theorem and principles of quantum mechanics, Pauli vectors

Week 3: Classical & Quantum correlation, Entanglement, From two states to many

Week 4: Simultaneous observables, Statistics of uncertainty, The uncertainty principle

Week 5: Developments leading up to the wave equation, Schrödinger's equation

Week 6: Flexibility week (no classes by university requirement)

Week 7: Wavefunctions and expectation values, Infinite and finite square wells, Quantum harmonic oscillators

Week 8: Time evolution and coherence, Fourier's theorems and Fourier transforms, Quantum propagation of a free particle

Week 9: Barriers and Steps, The delta function potential, Periodic potentials

Week 10: Revision sessions & tutorials only (unless public holidays require class shifts into this week)

Course Resources

Prescribed Resources

Nil

Recommended Resources

Recommended resources:

Introduction to Quantum Mechanics, 2nd Ed, David J Griffiths, ISBN 978-0-131-11892-8, Pearson Education

Quantum Mechanics – The Theoretical Minimum, Leonard Susskind & Art Friedman, ISBN 978-0-141-97781-2, Penguin Books

Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, 2nd Edition; Robert Eisberg & Robert Resnick, ISBN 978-0-47187-373-0, John Wiley and Sons.

Additional Costs

Nil

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Lecturer	Peter Reece					No	No
Lab supervisor	Tamara Reztsova					No	No
Administrator	Zofia Krawczyk					No	No
Convenor	Adam Micolich					No	Yes
Year coordinator	Elizabeth Angstmann					Yes	No

Other Useful Information

Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University's conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University's reputation and good standing.

For more information, visit the [UNSW Student Code of Conduct Website](#).

Academic Honesty and Plagiarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.

Further information about referencing styles can be located at <https://student.unsw.edu.au/referencing>

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect,

responsibility and courage. At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.

Further information about academic integrity, plagiarism and the use of AI in assessments can be located at:

- The [Current Students site](#),
- The [ELISE training site](#), and
- The [Use of AI for assessments](#) site.

The Student Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: <https://student.unsw.edu.au/conduct>

Submission of Assessment Tasks

Penalty for Late Submissions

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessments where a penalty applies,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: <https://student.unsw.edu.au/special-consideration>

Important note: UNSW has a “fit to sit/submit” rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for Special Consideration. This is to ensure that if you feel unwell or are faced with significant circumstances beyond your control that affect your ability to study, you do not sit an examination or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

Faculty-specific Information

Additional support for students

- [The Current Students Gateway](#)
- [Student Support](#)
- [Academic Skills and Support](#)
- [Student Wellbeing, Health and Safety](#)
- [Equitable Learning Services](#)
- [UNSW IT Service Centre](#)
- Science EDI Student [Initiatives](#), [Offerings](#) and [Guidelines](#)