



PHYS3140

Advanced Quantum Mechanics and Quantum Optics

Session 2, In person-scheduled-weekday, North Ryde 2026

School of Mathematical and Physical Sciences

Contents

<u>General Information</u>	2
<u>Learning Outcomes</u>	3
<u>General Assessment Information</u>	3
<u>Assessment Tasks</u>	4
<u>Delivery and Resources</u>	6
<u>Unit Schedule</u>	6
<u>Policies and Procedures</u>	6

Disclaimer

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

General Information

Unit convenor and teaching staff

Convenor

Christina Giarmatzi

christina.giarmatzi@mq.edu.au

Contact via email

12WW 405

Lecturer

Peter Turner

peter.turner@mq.edu.au

Contact via email

12WW 417

Credit points

10

Prerequisites

PHYS2030

Corequisites

Co-badged status

Unit description

Quantum mechanics is fundamental to modern physics. While its consequences are most readily seen in the microscopic world of elementary particles, atoms and molecules; quantum mechanics provides rules that apply to all physical phenomena: the universe as a whole is governed by its laws. This unit looks at quantum mechanics from a foundational perspective. After introducing the postulates of quantum theory, we consider the basic mathematical structures including Hilbert Space, the Dirac notation, linear operators, spectral theory and measurements. Tools for the description of multiple systems and statistical combinations of systems are introduced allowing the exploration of entanglement - arguably the most dramatic departure from classical physics. In the second half of the unit Quantum Optics is introduced, which has widespread applications and has played a central role in testing quantum mechanics and exploring its meaning. In this section we cover quantization of the optical field, introduce coherent states and describe the physics behind the quantum interaction of light and atoms.

Learning in this unit enhances student understanding of global challenges identified by the United Nations Sustainable Development Goals ([UNSDGs](#)) Industry, Innovation and Infrastructure

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

Learning Outcomes

On successful completion of this unit, you will be able to:

- ULO1:** describe and apply the Hilbert space formalism of quantum mechanics.
- ULO2:** model the combination and removal of physical systems.
- ULO3:** use density operators to describe the statistical properties of quantum mechanics.
- ULO4:** explain how measurements are described and used in quantum mechanics.

General Assessment Information

Requirements to Pass this Unit

To pass this unit you need to:

- *Achieve a total mark equal to or greater than 50% across all assessments*

Attendance and participation

We strongly encourage all students to actively participate in all learning activities. Regular engagement is crucial for your success in this unit, as these activities provide opportunities to

deepen your understanding of the material, collaborate with peers, and receive valuable feedback from instructors, to assist in completing the unit assessments. Your active participation not only enhances your own learning experience but also contributes to a vibrant and dynamic learning environment for everyone.

Late Assessment Submission Penalty

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark of the task) will be applied for each day a written report or presentation assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. The submission time for all uploaded assessments is 11:55 pm. A 1-hour grace period will be provided to students who experience a technical concern.

For any late submission of time-sensitive tasks, such as scheduled tests/exams, assignments, performance assessments/presentations, and/or scheduled practical assessments/labs, please apply for Special Consideration: <https://connect.mq.edu.au>

Assessments where Late Submissions will be accepted:

- Review portfolio – YES, Standard Late Penalty applies
- Viva & Final exam - NO, unless Special Consideration is Granted

Special Consideration

The Special Consideration Policy aims to support students who have been impacted by short-term circumstances or events that are serious, unavoidable and significantly disruptive, and which may affect their performance in assessment. If you experience circumstances or events that affect your ability to complete the assessments in this unit on time, please inform the convenor and submit a Special Consideration request through <https://connect.mq.edu.au>.

Written Assessments/Quizzes/Tests: If you experience circumstances or events that affect your ability to complete the written assessments in this unit on time, please inform the convenor and submit a Special Consideration request through <https://connect.mq.edu.au>.

Assessment Tasks

Name	Weighting	Hurdle	Due	Groupwork/Individual	Short Extension	AI Approach
Review portfolio	25%	No	11/09/2026	Individual	Yes	Open
Viva	25%	No	Week 13	Individual	No	Observed
Final Exam	50%	No	Exam Period	Individual	No	Observed

Review portfolio

Assessment Type ¹: Portfolio

Indicative Time on Task ²: 30 hours

Due: **11/09/2026**

Weighting: **25%**

Groupwork/Individual: Individual

Short extension ³: Yes

AI Approach: Open

You will create a portfolio consisting of your solutions to a set of problems along with the feedback you provide to and receive from peers.

On successful completion you will be able to:

- describe and apply the Hilbert space formalism of quantum mechanics.
- model the combination and removal of physical systems.
- use density operators to describe the statistical properties of quantum mechanics.
- explain how measurements are described and used in quantum mechanics.

Viva

Assessment Type ¹: Examination

Indicative Time on Task ²: 20 hours

Due: **Week 13**

Weighting: **25%**

Groupwork/Individual: Individual

Short extension ³: No

AI Approach: Observed

You will sit a viva/oral exam covering material in second half of unit.

On successful completion you will be able to:

- describe and apply the Hilbert space formalism of quantum mechanics.
- model the combination and removal of physical systems.
- use density operators to describe the statistical properties of quantum mechanics.
- explain how measurements are described and used in quantum mechanics.

Final Exam

Assessment Type ¹: Examination

Indicative Time on Task ²: 21 hours

Due: **Exam Period**

Weighting: **50%**

Groupwork/Individual: Individual

Short extension ³: No

AI Approach: Observed

You will undertake a final examination during the formal examination period.

On successful completion you will be able to:

- describe and apply the Hilbert space formalism of quantum mechanics.
- model the combination and removal of physical systems.
- use density operators to describe the statistical properties of quantum mechanics.
- explain how measurements are described and used in quantum mechanics.

¹ If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- [Academic Success](#) for academic skills support.

² Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation.

³ An automatic short extension is available for some assessments. Apply through the [Service Connect Portal](#).

Delivery and Resources

There are four hours of classes per week, *The timetable for classes can be found on the University website at: <https://publish.mq.edu.au/>.*

Suggested Textbooks

Material and notes will be provided. Suggested textbooks for supplementary study will be provided in class and in class notes.

Methods of Communication

We will communicate with you via your university email or through announcements on iLearn. Queries to convenors can either be placed on the iLearn discussion board or sent to your lecturers from your university email address.

Unit Schedule

Week 1-7	Quantum Theory (Peter Turner)
Week 8-13	Quantum Optics (Christina Giarmatzi)

Detailed breakdown of topics covered each week will be available in class resources.

Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](#) (<https://policies.mq.edu.au>). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- [Academic Appeals Policy](#)
- [Academic Integrity Policy](#)
- [Academic Progression Policy](#)
- [Assessment Policy](#)
- [Fitness to Practice Procedure](#)
- [Assessment Procedure](#)
- [Complaints Resolution Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#)

Students seeking more policy resources can visit [Student Policies](https://students.mq.edu.au/support/study/policies) (<https://students.mq.edu.au/support/study/policies>). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit [Policy Central](https://policies.mq.edu.au) (<https://policies.mq.edu.au>) and use the [search tool](#).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: <https://students.mq.edu.au/admin/other-resources/student-conduct>

Results

Results published on platform other than [eStudent](#), (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in [eStudent](#). For more information visit connect.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Academic Integrity

At Macquarie, we believe [academic integrity](#) – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free [online writing and maths support](#), [academic skills development](#) and [wellbeing consultations](#).

Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

Academic Success

[Academic Success](#) provides resources to develop your English language proficiency, academic writing, and communication skills.

- [Ask a Study Coach](#)
- [Access StudyWISE](#)

- [Upload an assignment to Studiosity](#)
- [Complete the Academic Integrity Module](#)

The Library provides online and face to face support to help you find and use relevant information resources.

- [Subject and Research Guides](#)
- [Ask a Librarian](#)

Student Services and Support

Macquarie University offers a range of [Student Support Services](#) including:

- [IT Support](#)
- [Accessibility and disability support](#) with study
- Mental health [support](#)
- [Safety support](#) to respond to bullying, harassment, sexual harassment and sexual assault
- [Social support including information about finances, tenancy and legal issues](#)
- [Student Advocacy](#) provides independent advice on MQ policies, procedures, and processes

Student Enquiries

Got a question? Ask us via the [Service Connect Portal](#), or contact [Service Connect](#).

IT Help

For help with University computer systems and technology, visit <https://students.mq.edu.au/support/technology/service-desk>.

When using the University's IT, you must adhere to the [Acceptable Use of IT Resources Policy](#). The policy applies to all who connect to the MQ network including students.

Unit information based on version 2026.03 of the [Handbook](#)