PHYS8909

Quantum Control

Session 2, In person-scheduled-weekday, North Ryde 2023

School of Mathematical and Physical Sciences

Contents

General Information

Unit convenor and teaching staff
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Lecturer, Convenor
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Credit points
10

Prerequisites
Permission by special approval

Corequisites

Co-badged status
Phys7909

Unit description
Acquiring information and control are two key aspects of quantum technology that are critical for the successful development and application of quantum devices. Information acquisition requires the use of advanced formalism and techniques for quantum measurements, sensing, and characterisation, which enable researchers to probe the quantum world in unprecedented detail. Furthermore, once information about a quantum system has been obtained, it is often necessary to apply control techniques to manipulate its state and behaviour. The unit introduces students to the formalism of quantum measurements and characterisation techniques, and methods for quantum control. The unit also covers practical application of these techniques using Python quantum modelling libraries.

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: Demonstrate advanced disciplinary knowledge and skills in quantum information.

ULO2: Explain basic concepts of measurement and control of quantum systems and

apply them to low-dimensional quantum systems.

ULO3: Use theoretical quantum frameworks to model simple quantum systems.

ULO4: Use numerical packages to model simple quantum systems.

ULO5: Effectively communicate physical arguments in quantum information through explanation in assessment tasks.

General Assessment Information

In order to pass the unit, you must achieve a total mark equal or greater than 50%. The unit does not have any hurdle tasks.

Late submission of assessments is accepted. The Standard Late Penalty applies.

Assessment Tasks

Name	Weighting	Hurdle	Due
Problem sets	30%	No	Throughout semester
Oral examination	40%	No	S2 examination period
Project report	30%	No	Throughout semester

Problem sets

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 30 hours
Due: **Throughout semester**
Weighting: **30%**

A sequence of problem sets throughout the session.

On successful completion you will be able to:

- Demonstrate advanced disciplinary knowledge and skills in quantum information.
- Explain basic concepts of measurement and control of quantum systems and apply them to low-dimensional quantum systems.
- Use theoretical quantum frameworks to model simple quantum systems.
- Use numerical packages to model simple quantum systems.
- Effectively communicate physical arguments in quantum information through explanation in assessment tasks.

Oral examination

Assessment Type [1]: Viva/oral examination
Indicative Time on Task [2]: 20 hours
Due: **S2 examination period**
Weighting: **40%**

Oral examination in the Examination Period covering all course content

On successful completion you will be able to:

- Demonstrate advanced disciplinary knowledge and skills in quantum information.
- Explain basic concepts of measurement and control of quantum systems and apply them to low-dimensional quantum systems.
- Use theoretical quantum frameworks to model simple quantum systems.
- Effectively communicate physical arguments in quantum information through explanation in assessment tasks.

Project report

Assessment Type [1]: Report
Indicative Time on Task [2]: 32 hours
Due: **Throughout semester**
Weighting: **30%**

Reports for numerical and computational projects

On successful completion you will be able to:

- Demonstrate advanced disciplinary knowledge and skills in quantum information.
- Explain basic concepts of measurement and control of quantum systems and apply them to low-dimensional quantum systems.
- Use theoretical quantum frameworks to model simple quantum systems.
- Use numerical packages to model simple quantum systems.
- Effectively communicate physical arguments in quantum information through explanation in assessment tasks.

[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
- the Writing Centre 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

Delivery and Resources

Lectures and SGTAs with supporting reference and practice material.

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). 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) 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 ask.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/

The Writing Centre

The Writing Centre provides resources to develop your English language proficiency, academic writing, and communication skills.

- Workshops
- Chat with a WriteWISE peer writing leader
- 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 AskMQ, or contact Service Connect.

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

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.

Changes from Previous Offering

First half of unit now focuses on quantum measurement and estimation - a critical aspect of the quantum control stack.