



# PHYS7901

## Mathematical Methods in Physics

Session 1, Weekday attendance, North Ryde 2021

*Department of Physics and Astronomy*

### Contents

---

<a href="#">General Information</a>	2
<a href="#">Learning Outcomes</a>	3
<a href="#">Assessment Tasks</a>	3
<a href="#">Delivery and Resources</a>	5
<a href="#">Policies and Procedures</a>	5
<a href="#">Changes since First Published</a>	7

#### 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.

#### Notice

As part of [Phase 3 of our return to campus plan](#), most units will now run tutorials, seminars and other small group activities on campus, and most will keep an online version available to those students unable to return or those who choose to continue their studies online.

To check the availability of face-to-face activities for your unit, please go to [timetable viewer](#). To check detailed information on unit assessments visit your unit's iLearn space or consult your unit convenor.

## General Information

Unit convenor and teaching staff

Lecturer and Convenor

Mark Wardle

[mark.wardle@mq.edu.au](mailto:mark.wardle@mq.edu.au)

7WW 2.702

Lecturer

Gavin Brennen

[gavin.brennen@mq.edu.au](mailto:gavin.brennen@mq.edu.au)

7WW 2.611

Credit points

10

Prerequisites

Admission to MRes

Corequisites

Co-badged status

Unit description

This unit covers topics in mathematical physics including: differential equations and group theory. The aim is to develop effective problem solving strategies, and where possible, the examples will be taken from the physical sciences. In the first topic the primary focus is on ordinary differential equations covering topics from first order equations and how to classify and solve them, through to higher order equations and more general techniques such as reduction of order, Laplace transforms, Green functions and series solutions. The second topic covers discrete groups and continuous Lie groups and Lie algebras. Group representations are introduced with the examples from Abelian and non-Abelian groups. Irreducible representations, unitary representations, Shur's Lemma, and orthogonality relations are covered in the context of discrete groups. Compact and non-compact Lie groups and their generating Lie algebras are presented with several examples making the connection between symmetries and conservation laws, e.g. space-time symmetries and the Poincare group.

## Important Academic Dates

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

## Learning Outcomes

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

**ULO1:** apply analytic methods for solving linear differential equations.

**ULO2:** describe and use numerical methods for solving ordinary or partial differential equations.

**ULO3:** employ discrete groups, continuous Lie groups and Lie algebras, and representation theory.

**ULO4:** infer discrete and continuous symmetries from the properties of physical systems.

**ULO5:** explain the relations between symmetries and conservation laws.

**ULO6:** analyse differential equations and group theory using Mathematica.

## Assessment Tasks

Name	Weighting	Hurdle	Due
<a href="#">Final examination</a>	40%	No	University Examination Period
<a href="#">Problem-based assignments</a>	20%	No	See unit schedule on iLearn
<a href="#">Midsession exam</a>	40%	No	See unit schedule on iLearn

### Final examination

Assessment Type <sup>1</sup>: Examination

Indicative Time on Task <sup>2</sup>: 21 hours

Due: **University Examination Period**

Weighting: **40%**

Final examination covering all content from the course.

On successful completion you will be able to:

- apply analytic methods for solving linear differential equations.
- describe and use numerical methods for solving ordinary or partial differential equations.
- employ discrete groups, continuous Lie groups and Lie algebras, and representation theory.
- infer discrete and continuous symmetries from the properties of physical systems.
- explain the relations between symmetries and conservation laws.

## Problem-based assignments

Assessment Type <sup>1</sup>: Problem set

Indicative Time on Task <sup>2</sup>: 32 hours

Due: **See unit schedule on iLearn**

Weighting: **20%**

Sets of problems based on lecture content

On successful completion you will be able to:

- apply analytic methods for solving linear differential equations.
- describe and use numerical methods for solving ordinary or partial differential equations.
- employ discrete groups, continuous Lie groups and Lie algebras, and representation theory.
- infer discrete and continuous symmetries from the properties of physical systems.
- explain the relations between symmetries and conservation laws.
- analyse differential equations and group theory using Mathematica.

## Midsession exam

Assessment Type <sup>1</sup>: Quiz/Test

Indicative Time on Task <sup>2</sup>: 11 hours

Due: **See unit schedule on iLearn**

Weighting: **40%**

Exam on content from the first half of the unit

On successful completion you will be able to:

- apply analytic methods for solving linear differential equations.
- describe and use numerical methods for solving ordinary or partial differential equations.

---

<sup>1</sup> 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 [Learning Skills Unit](#) for academic skills support.

<sup>2</sup> 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

### Classes

Mixed Lecture and Tutorial/discussion, as well as work on Mathematica in the PC laboratory.

### Required and Recommended Texts

The recommended texts are :

- "Mathematical Methods for Physics and Engineering" by Riley, Hobson and Bence
- "Physical Mathematics" by Kevin Cahill

### Teaching and Learning Strategy

The theoretical aspects of this unit are taught in lectures and tutorials with fortnightly assignments to strengthen the understanding of the material. In addition there will be problem solving sessions using Mathematica in the PC laboratory. The material is heavily mathematical in nature, and often abstract, and true understanding can only be achieved through testing and refining understanding through problem solving.

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central \(https://policies.mq.edu.au\)](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](#)
- [Grade Appeal Policy](#)
- [Complaint Management 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 [ask.mq.edu.au](http://ask.mq.edu.au) or if you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@mq.edu.au)

## Student Support

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

## Learning Skills

Learning Skills ([mq.edu.au/learningskills](http://mq.edu.au/learningskills)) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- [Getting help with your assignment](#)
- [Workshops](#)
- [StudyWise](#)
- [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 Enquiry Service

For all student enquiries, visit Student Connect at [ask.mq.edu.au](http://ask.mq.edu.au)

If you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@mq.edu.au)

## Equity Support

Students with a disability are encouraged to contact the [Disability Service](#) who can provide appropriate help with any issues that arise during their studies.

## IT Help

For help with University computer systems and technology, visit [http://www.mq.edu.au/about\\_us/offices\\_and\\_units/information\\_technology/help/](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 since First Published

Date	Description
23/02/2021	Fixed typo in email address.