



PHYS7901

Mathematical Methods in Physics

Session 1, In person-scheduled-weekday, North Ryde 2022

School of Mathematical and Physical Sciences

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General Information

Unit convenor and teaching staff

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Lecturer

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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, Schur'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://www.mq.edu.au/study/calendar-of-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
Final examination	40%	No	University Examination Period
Problem-based assignments	20%	No	See unit schedule on iLearn
Midsession exam	40%	No	See unit schedule on iLearn

Final examination

Assessment Type ¹: Examination

Indicative Time on Task ²: 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 ¹: Problem set

Indicative Time on Task ²: 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 ¹: Quiz/Test

Indicative Time on Task ²: 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.

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

Classes

Mixed Lecture and Tutorial/discussion.

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. 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](#)
- [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 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 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.