MATH2030

Modelling with Differential Equations

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

School of Mathematical and Physical Sciences

Contents

General Information

Unit convenor and teaching staff
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Credit points
10

Prerequisites
MATH2010 or MATH2055

Corequisites

Co-badged status

Unit description
This unit develops techniques for formulating, solving and analysing mathematical models of physical systems, with applications including population dynamics, the spread of infectious diseases, and tumour-immune cell interactions. Differential equations are fundamental tools for describing the evolution of such systems over time or space and are central to many areas of science and engineering, from modelling chemical reactions and ecological interactions to mechanical vibrations and electrical circuits. The unit integrates mathematical theory with practical application, showing how differential equations can yield deep insight and predictive power in real-world contexts. A key focus is the study of dynamical systems methods, including the analysis of critical points and their stability, to understand long-term system behaviour. Students will learn to derive and interpret differential equations, apply powerful analytical techniques to solve them, and use complementary numerical methods to explore more complex or nonlinear models.

Learning in this unit enhances student understanding of global challenges identified by the United Nations Sustainable Development Goals (UNSDGs) Good Health and Well Being; Quality Education; Decent Work and Economic Growth; 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: Formulate a mathematical model of a physical system.

ULO2: Interpret a mathematical model to determine the qualitative behaviour of the physical system that it represents.

ULO3: Apply mathematical techniques to quantitatively analyse the behaviour of mathematical models that vary with time or space.

ULO4: Translate solutions and results of mathematical models into implications and predictions for the original physical system being modelled.

ULO5: Utilise software to numerically obtain, present, and communicate results pertaining to the behaviour of a physical system.

General Assessment Information

Requirements to Pass this Unit

To pass this unit you must:

- Achieve a total mark equal to or greater than 50%

Late Assessment Submission Penalty

Please see https://students.mq.edu.au/study/assessment-exams/assessments for more information.

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark) will be applied each day a written 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. Submission time for all written assessments is set at 11:55 pm. A 1-hour grace period is provided to students who experience a technical concern.

For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, students need to submit an application for Special Consideration.

Assessments where Late Submissions will be accepted

- Assignment – YES, Standard Late Penalty applies
- Project – YES, Standard Late Penalty applies

- 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.

Assessment Tasks

Name	Weighting	Hurdle	Due	Groupwork/Individual	Short Extension	AI Approach
Assignment	20%	No	18/09/2026	Individual	Yes	Open
Project	30%	No	30/10/2026	Individual and Group	No	Open
Final Exam	50%	No	Examination Period	Individual	No	Observed

Assignment

Assessment Type [1]: Problem-based task
Indicative Time on Task [2]: 12 hours
Due: **18/09/2026**
Weighting: **20%**
Groupwork/Individual: Individual
Short extension [3]: Yes
AI Approach: Open

The assignment will test the ability of students to solve mathematical problems using concepts and techniques learnt in the unit.

On successful completion you will be able to:

- Formulate a mathematical model of a physical system.
- Interpret a mathematical model to determine the qualitative behaviour of the physical system that it represents.
- Apply mathematical techniques to quantitatively analyse the behaviour of mathematical models that vary with time or space.
- Translate solutions and results of mathematical models into implications and predictions for the original physical system being modelled.
- Utilise software to numerically obtain, present, and communicate results pertaining to the behaviour of a physical system.

Project

Assessment Type [1]: Experiential task
Indicative Time on Task [2]: 18 hours
Due: **30/10/2026**
Weighting: **30%**
Groupwork/Individual: Individual and Group
Short extension [3]: No
AI Approach: Open

This project gives students the opportunity to apply the knowledge gained in the unit to a larger scale mathematical problem than the short questions typical in assignments.

On successful completion you will be able to:

- Formulate a mathematical model of a physical system.
- Interpret a mathematical model to determine the qualitative behaviour of the physical system that it represents.
- Apply mathematical techniques to quantitatively analyse the behaviour of mathematical models that vary with time or space.
- Translate solutions and results of mathematical models into implications and predictions for the original physical system being modelled.
- Utilise software to numerically obtain, present, and communicate results pertaining to the behaviour of a physical system.

Final Exam

Assessment Type [1]: Examination
Indicative Time on Task [2]: 20 hours
Due: **Examination 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:

- Formulate a mathematical model of a physical system.
- Interpret a mathematical model to determine the qualitative behaviour of the physical system that it represents.
- Apply mathematical techniques to quantitatively analyse the behaviour of mathematical models that vary with time or space.

- Translate solutions and results of mathematical models into implications and predictions for the original physical system being modelled.
- Utilise software to numerically obtain, present, and communicate results pertaining to the behaviour of a physical system.

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[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

Classes

Lectures (beginning in Week 1): There are two one-hour lectures each week.

SGTA classes (beginning in Week 2): Students should attend one two-hour class per week.

The timetable for classes can be found on the University website at: http://publish.mq.edu.au/

Enrolment can be managed using eStudent at: https://students.mq.edu.au/support/technology/systems/estudent

Suggested Textbooks

There is no set textbook for MATH2030.

Technology Used and Required

This subject requires the use of Matlab and LaTeX, which are free to Macquarie University students.

- **Matlab**:
  - Access and installation instructions available at: https://au.mathworks.com/academia/tah-portal/macquarie-university-916052.html
  - Students may also use the free online Matlab implementation using their university licence, at https://au.mathworks.com/products/matlab-online.html
- **LaTeX**:
  - Access and installation instructions available at: https://www.latex-project.org/ge

t/

- Students may also use the free online LaTeX compiler, Overleaf, at: https://www.overleaf.com

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	UNIT SCHEDULE (guide only)	ASSESSMENT DUE
	Introduction to modelling; Compartment modelling	
	Compartment modelling continued; Dimensional analysis	Exercise 1; Select projects
	First-order ODEs and their solutions; Logistic equation; phase lines & stability	Exercise 2
	Harvesting & bifurcations	Exercise 3
	Systems of first-order ODEs; Solutions to linear systems	Exercise 4
	Stability of linear systems; Classifications & phase planes	Exercise 5; Submit project model for formative feedback
	Nonlinear systems of ODEs; Linear stability; Constructing phase planes	Exercise 6
	Population models; Lotka-Volterra Predator-Prey	Exercise 7; Assignment due
	Infectious disease models; SIR model	Exercise 8
	Second-order ODEs; Mass-spring systems	Exercise 9
	Boundary value problems; Nonlinear effects	Exercise 10
	Nonlinear effects continued; Power series	Exercise 11; Project report due
	Revision	Exercise 12

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 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.

Changes from Previous Offering

MATH2030 replaces MATH2110, with most of the content unchanged, and additionally includes solutions to first-order ordinary differential equations.

Unit information based on version 2026.01 of the Handbook