MATH2110

Mathematical Modelling and Differential Equations

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

School of Mathematical and Physical Sciences

Contents

General Information	2
Learning Outcomes	2
General Assessment Information	3
Assessment Tasks	4
Delivery and Resources	6
Unit Schedule	8
Policies and Procedures	8
Changes from Previous Offering	10

General Information

Unit convenor and teaching staff
Unit Convenor
Christian Thomas
christian.thomas@mq.edu.au
Contact via Email
726, 12WW

Unit Convenor
Catherine Penington
catherine.penington@mq.edu.au
Contact via Email
717, 12WW

Credit points
10

Prerequisites
MATH2010 or MATH235 or MATH2055

Corequisites

Co-badged status

Unit description
This unit builds upon 1000-level mathematical modelling methods and develops new techniques for both formulating and analysing mathematical models of physical systems. Theory and application will be presented in an integrative way, emphasising the utility of mathematical methods in obtaining information and making predictions about real-world processes. The unit will focus particularly on how to interpret and derive differential equations describing (possibly coupled) physical systems that either vary in time or space. Powerful methods, and their theoretical foundations, will be introduced to analyse and solve these differential equations. Complementary numerical techniques will be used in some of the methods, preparing students for analyses of more intricate problems.

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: Interpret a mathematical model in order to determine the qualitative behaviour of the physical system that it represents.
ULO2: Formulate a simplified mathematical model of a complex physical system.
ULO3: Apply mathematical techniques to quantitatively analyse the behaviour of mathematical models that vary with time and 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

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, performance assessments/presentations, and/or scheduled practical assessments/labs, please apply for Special Consideration.

Assessments where Late Submissions will be accepted

- Assignment 1 – YES, Standard Late Penalty applied
- Assignment 2 – YES, Standard Late Penalty applies
- Major Project – YES, Standard Late Penalty applies
- Examination - 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 ask.mq.edu.au.

Written Assessments: 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 ask.mq.edu.au.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	10%	No	Week 5
Major Project	30%	No	Week 7 & Week 12
Assignment 2	10%	No	Week 11
Examination	50%	No	Final Examination Period

Assignment 1

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 6 hours
Due: **Week 5**
Weighting: **10%**

This assignment will test the ability of students to develop and analyse mathematical problems using concepts and techniques from mathematical modelling and applied mathematics.

On successful completion you will be able to:

- Interpret a mathematical model in order to determine the qualitative behaviour of the physical system that it represents.
- Formulate a simplified mathematical model of a complex physical system.
- Apply mathematical techniques to quantitatively analyse the behaviour of mathematical models that vary with time and 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.

Major Project

Assessment Type [1]: Project

Indicative Time on Task [2]: 20 hours
Due: **Week 7 & Week 12**
Weighting: **30%**

The students will be assigned a mathematical modelling task in groups. They will be required to develop and analyse a mathematical model to draw conclusions. The students will be required to submit individual written reports.

On successful completion you will be able to:

- Interpret a mathematical model in order to determine the qualitative behaviour of the physical system that it represents.
- Formulate a simplified mathematical model of a complex physical system.
- Apply mathematical techniques to quantitatively analyse the behaviour of mathematical models that vary with time and 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.

Assignment 2

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 6 hours
Due: **Week 11**
Weighting: **10%**

This assignment will test the ability of students to develop and analyse mathematical problems using concepts and techniques from mathematical modelling and applied mathematics.

On successful completion you will be able to:

- Interpret a mathematical model in order to determine the qualitative behaviour of the physical system that it represents.
- Formulate a simplified mathematical model of a complex physical system.
- Apply mathematical techniques to quantitatively analyse the behaviour of mathematical models that vary with time and 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.

Examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 20 hours
Due: **Final Examination Period**
Weighting: **50%**

This will be held during the final exam period. It will test the ability of students to utilise the concepts taught in the course to develop mathematical models, and apply appropriate techniques to analyse and interpret these models.

On successful completion you will be able to:

- Interpret a mathematical model in order to determine the qualitative behaviour of the physical system that it represents.
- Formulate a simplified mathematical model of a complex physical system.
- Apply mathematical techniques to quantitatively analyse the behaviour of mathematical models that vary with time and 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.

---

[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

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

1-6 will be supplemented by short videos.)

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

Suggested textbooks

There is no set textbook for MATH2110.

Required Materials

This subject requires the use of several items of software. Each of these is available to you at no cost, either because the software is open source or otherwise freely available, or because Macquarie University has arranged access for students. You will need the following:

- **Matlab**: Macquarie University provides Matlab access on a wide range of computing platforms. You will be required to sign up with Mathworks using your student email account.
    - Access and installation instructions may be found 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, found at https://au.mathworks.com/products/matlab-online.html
- **LaTeX**: LaTeX is a free mathematical typesetting program.
    - Access and installation instructions may be found at: https://www.latex-project.org/get/
    - Students may also use the free online LaTeX compiler, Overleaf, which is found 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.

COVID Information

For the latest information on the University's response to COVID-19, please refer to the Coronavirus infection page on the Macquarie website: https://www.mq.edu.au/about/coronavirusfaqs. Remember to check this page regularly in case the information and requirements change during semester. If there are any changes to this unit in relation to COVID, these will be communicated via iLearn.

Unit Schedule

WEEK	UNIT SCHEDULE (guide only)	ASSESSMENT DUE
	Introduction to modelling; Compartment modelling	
	Compartment modelling continued; Dimensional analysis	Projects released; Exercise 1
	First-order ODEs; Logistic equation; phase lines & stability	Assignment 1 released; Exercise 2
	Harvesting & bifurcations; Numerical methods	Exercise 3
	Systems of first-order ODEs; Solutions to linear systems	Assignment 1 Due; Exercise 4
	Stability of linear systems; Classifications & phase planes	Exercise 5
	Nonlinear systems of ODEs; Linear stability; Constructing phase planes	Project Presentation Slides Due; Exercise 6
	Population models; Lotka-Volterra Predator-Prey	Exercise 7
	Infectious disease models; SIR model	Assignment 2 released; Exercise 8
	Second-order ODEs; Mass-spring systems	Exercise 9
	Boundary value problems; Nonlinear effects	Assignment 2 Due; Exercise 10
	Nonlinear effects continued; Power series	Project Written Report Due; Exercise 11
	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 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

We value student feedback to be able to continually improve the way we offer our units. As such we encourage students to provide constructive feedback via student surveys, to the teaching staff directly, or via the FSE Student Experience & Feedback link in the iLearn page. Student feedback from the previous offering of this unit was very positive overall, with students pleased with the clarity around assessment requirements and the level of support from teaching staff. As such, no change to the delivery of the unit is planned, however we will continue to strive to improve the level of support and the level of student engagement.