MATH2110

Mathematical Modelling and Differential Equations

Session 2, Special circumstances 2021

Archive (Pre-2022) - Department of Mathematics and Statistics

Contents

Session 2 Learning and Teaching Update

The decision has been made to conduct study online for the remainder of Session 2 for all units WITHOUT mandatory on-campus learning activities. Exams for Session 2 will also be online where possible to do so.

This is due to the extension of the lockdown orders and to provide certainty around arrangements for the remainder of Session 2. We hope to return to campus beyond Session 2 as soon as it is safe and appropriate to do so.

Some classes/teaching activities cannot be moved online and must be taught on campus. You should already know if you are in one of these classes/teaching activities and your unit convenor will provide you with more information via iLearn. If you want to confirm, see the list of units with mandatory on-campus classes/teaching activities.

Visit the MQ COVID-19 information page for more detail.

General Information

Unit convenor and teaching staff
Unit Convenor/Lecturer
Christian Thomas
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Contact via Email
Please refer to iLearn

Lecturer
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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

HURDLES: This unit has no hurdle requirements.

ASSIGNMENT SUBMISSION: Assignment submission will be online through the iLearn page.

Submit assignments online via the appropriate assignment link on the iLearn page. A personalised cover sheet is not required with online submissions. Read the submission statement carefully before accepting it as there are substantial penalties for making a false declaration.

- Assignment submission is via iLearn.
- Please note the quick guide on how to upload your assignments provided on the iLearn page.
- Please make sure that each page in your uploaded assignment corresponds to only one A4 page (do not upload an A3 page worth of content as an A4 page in landscape). If you are using an app like Clear Scanner, please make sure that the photos you are using are clear and shadow-free.
- It is your responsibility to make sure your assignment submission is legible.
- If there are technical obstructions to your submitting online, please email us to let us know.

You may submit as often as required prior to the due date/time. Please note that each submission will completely replace any previous submissions. It is in your interests to make frequent submissions of your partially completed work as insurance against technical or other

problems near the submission deadline.

LATE SUBMISSION: All assignments must be submitted by the official due date and time. No marks will be given for late work unless an extension has been granted following a successful application for Special Consideration. Please contact one of the unit convenors for advice as soon as you become aware that you may have difficulty meeting any of the assignment deadlines. It is in your interests to make frequent submissions of your partially completed work. Note that later submissions completely replace any earlier submission, and so only the final submission made before the due date will be marked.

FINAL EXAM POLICY: It is Macquarie University policy not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, that is, the final day of the official examination period. The only excuse for not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these special circumstances, you may apply for special consideration via ask.mq.edu.au.

SPECIAL CONSIDERATION: If you receive special consideration for the final exam, a supplementary exam will be scheduled in the interval between the regular exam period and the start of the next session. By making a special consideration application for the final exam you are declaring yourself available for a resit during this supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application.

You can check the supplementary exam information page on FSE101 in iLearn (bit.ly/FSESupp) for dates, and approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	10%	No	Week 5
Assignment 2	10%	No	Week 11
Major Project	30%	No	Week 7 & Week 12
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.

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.

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.

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.

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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
- 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:

In lectures, concepts are introduced, explained and illustrated. The content of the unit will be explained and example problems will be solved, and applications discussed. There will be two hours of lectures each week.

Small Group Teaching Activities:

The students will participate in weekly small group teaching activities (SGTAs). The students will work through example problems that require applying the mathematical and computational techniques introduced in the lectures. There will be one hour of SGTAs each week.

Required Materials:

This subject requires the use of the following computer software:

- **Matlab**: Macquarie University provides Matlab access on a wide range of computing platforms. Access and installation instructions may be found at: https://staff.mq.edu.au/intranet/science-and-engineering/services-and-resources/it-support-services/miscellaneous/matlab

It is recommended that students use the following computer software to prepare reports:

- **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

Unit Schedule

WEEK	UNIT SCHEDULE (guide only)	ASSESSMENT DUE
	Introduction to modelling Derive mathematical models Compartment modelling	
	Compartment modelling continued Dimensional analysis	Projects released Exercise 1
	First-order ODEs Logistic equation, phase lines & stability Solutions	Assignment 1 released Exercise 2
	Harvesting & bifurcations Numerical methods	Exercise 3
	Systems of first-order ODEs Solutions to linear systems Homogeneous & nonhomogeneous	Assignment 1 due Exercise 4
	Stability of linear systems Classifications & phase planes	Exercise 5
	MID-SESSIN BREAK	
	Nonlinear systems of ODEs Linear stability Constructing phase planes	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	Exercise 11
	Revision	Project Report Due 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
- 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). 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

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) 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 Services and 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.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

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.