



# MATH3905

## Methods for Mathematical Computation

Session 1, In person-scheduled-weekday, North Ryde 2023

*School of Mathematical and Physical Sciences*

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## General Information

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Credit points

10

Prerequisites

(MATH2010 or MATH235) and (MATH2020 or MATH2110 or MATH236 or MATH232)

Corequisites

Co-badged status

Unit description

This unit develops the ideas and techniques of numerical analysis that allow computers to study complicated, realistic problems that are challenging or impossible to solve using analytic calculation. Topics in this unit include the basic theory of numerical analysis, computational solutions to differential equations, and numerical linear algebra. We will first introduce important ideas such as computational complexity and measures of numerical error. This will be followed by the study of computational methods for solving large linear systems and partial differential equations.

## 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:** Understand and apply fundamental principles and concepts of numerical analysis and mathematical computation.

**ULO2:** Utilise mathematical software to implement algorithmic processes for solving mathematical problems.

**ULO3:** Design computational approaches to solve partial differential equations arising from science and engineering on finite domains.

**ULO4:** Determine solutions to large linear systems of equations using computationally efficient algorithmic approaches.

**ULO5:** Evaluate the effectiveness of computational algorithms using mathematical concepts including computational complexity and error bounds.

## 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

- Problem Set 1 – YES, Standard Late Penalty applies
- Problem Set 2 – YES, Standard Late Penalty applies
- Midsession quiz – NO, unless Special Consideration is Granted
- 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.

Written Assessments/Quizzes/Tests: 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](https://ask.mq.edu.au).

## Assessment Tasks

Name	Weighting	Hurdle	Due
<a href="#">Midsession quiz</a>	10%	No	Week 8
<a href="#">Problem Set 1</a>	20%	No	Week 6
<a href="#">Problem Set 2</a>	20%	No	Week 12
<a href="#">Final Exam</a>	50%	No	Exam Period

### Midsession quiz

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

Indicative Time on Task <sup>2</sup>: 10 hours

Due: **Week 8**

Weighting: **10%**

A midsession quiz on all aspects of the course material.

On successful completion you will be able to:

- Understand and apply fundamental principles and concepts of numerical analysis and mathematical computation.
- Utilise mathematical software to implement algorithmic processes for solving mathematical problems.
- Design computational approaches to solve partial differential equations arising from science and engineering on finite domains.
- Determine solutions to large linear systems of equations using computationally efficient algorithmic approaches.
- Evaluate the effectiveness of computational algorithms using mathematical concepts including computational complexity and error bounds.

### Problem Set 1

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

Indicative Time on Task <sup>2</sup>: 15 hours

Due: **Week 6**

Weighting: **20%**

Problem set requiring the design and implementation of numerical finite difference methods.

On successful completion you will be able to:

- Understand and apply fundamental principles and concepts of numerical analysis and mathematical computation.
- Utilise mathematical software to implement algorithmic processes for solving mathematical problems.
- Design computational approaches to solve partial differential equations arising from science and engineering on finite domains.
- Determine solutions to large linear systems of equations using computationally efficient algorithmic approaches.

## Problem Set 2

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

Indicative Time on Task <sup>2</sup>: 15 hours

Due: **Week 12**

Weighting: **20%**

Problem set requiring the design and implementation of methods for numerical linear algebra.

On successful completion you will be able to:

- Understand and apply fundamental principles and concepts of numerical analysis and mathematical computation.
- Utilise mathematical software to implement algorithmic processes for solving mathematical problems.
- Determine solutions to large linear systems of equations using computationally efficient algorithmic approaches.
- Evaluate the effectiveness of computational algorithms using mathematical concepts including computational complexity and error bounds.

## Final Exam

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

Indicative Time on Task <sup>2</sup>: 15 hours

Due: **Exam Period**

Weighting: **50%**

This will be an invigilated exam, held in the exam period. It will test the ability of students to synthesise the concepts taught in the course in order to analyse and solve mathematical problems with various applications.

On successful completion you will be able to:

- Understand and apply fundamental principles and concepts of numerical analysis and mathematical computation.
- Utilise mathematical software to implement algorithmic processes for solving mathematical problems.
- Design computational approaches to solve partial differential equations arising from science and engineering on finite domains.
- Determine solutions to large linear systems of equations using computationally efficient algorithmic approaches.
- Evaluate the effectiveness of computational algorithms using mathematical concepts including computational complexity and error bounds.

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<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 [Writing Centre](#) 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**

- Lectures (beginning in Week 1): There are two one-hour lectures each week.
- SGTA classes (beginning in Week 2): There is one one-hour SGTA each week.

### **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	Topics
1	Computer arithmetic
2	Interpolation and quadrature
3	Composite quadrature rules
4	Nonlinear equations
5	Initial value problems for ODEs
6	Systems and boundary value problems for ODEs
7	LU factorisation
8	Error analysis and QR factorisation
9	Householder and least squares
10	PDEs including classification and finite difference
11	PDEs including finite difference
12	PDEs

## 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](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)

## 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/](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
03/02/2023	Modified topics
24/01/2023	Added names