MATH3905

Methods for Mathematical Computation

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

School of Mathematical and Physical Sciences

Contents

General Information

Unit convenor and teaching staff
Unit convenor
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Lecturer
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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

The midsession quiz and exam must be undertaken at the time indicated in iLearn. Should these activities be missed due to illness or misadventure, students may apply for Special Consideration.

All other assessments must be submitted by 5:00 pm on their due date.

Should these assessments be missed due to illness or misadventure, students should apply for Special Consideration.

Late submissions of Problem Set 1 and Problem Set 2 are permitted. A consistent penalty will be applied for late submissions as follows:

A 12-hour grace period will be given after which the following deductions will be applied to the awarded assessment mark:

- 12 to 24 hours late = 10% deduction;
- for each day thereafter, an additional 10% per day or part thereof will be applied until five days beyond the due date.
- After this time, a mark of zero (0) will be given.

For example, an assessment worth 20% is due 5 pm on 1 January. Student A submits the assessment at 1 pm, 3 January. The assessment received a mark of 15/20. A 20% deduction is then applied to the mark of 15, resulting in the loss of three (3) marks. Student A is then awarded a final mark of 12/20.

Assessment Tasks

Name	Weighting	Hurdle	Due
Problem Set 1	20%	No	Week 6
Midsession quiz	10%	No	Week 8
Final Exam	50%	No	Examination period
Problem Set 2	20%	No	Week 12

Problem Set 1

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 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.

Midsession quiz

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 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.

Final Exam

Assessment Type [1]: Examination
Indicative Time on Task [2]: 15 hours
Due: **Examination 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.

Problem Set 2

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 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.

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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

Off-shore students **must** email the convenor as soon as possible to discuss study options.

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 separation
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). 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 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.