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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|--------------------------------|---------------------------------------------------------|
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739, 12WW |
| 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](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.
Assessment Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Hurdle</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midsession quiz</td>
<td>10%</td>
<td>No</td>
<td>Week 8</td>
</tr>
<tr>
<td>Problem Set 1</td>
<td>20%</td>
<td>No</td>
<td>Week 6</td>
</tr>
<tr>
<td>Problem Set 2</td>
<td>20%</td>
<td>No</td>
<td>Week 12</td>
</tr>
<tr>
<td>Final Exam</td>
<td>50%</td>
<td>No</td>
<td>Exam Period</td>
</tr>
</tbody>
</table>

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.

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.

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.

Final Exam
Assessment Type 1: Examination
Indicative Time on Task 2: 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.

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.
- 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

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Computer arithmetic</td>
</tr>
<tr>
<td>2</td>
<td>Interpolation and quadrature</td>
</tr>
<tr>
<td>3</td>
<td>Composite quadrature rules</td>
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<tr>
<td>4</td>
<td>Nonlinear equations</td>
</tr>
<tr>
<td>5</td>
<td>Initial value problems for ODEs</td>
</tr>
<tr>
<td>6</td>
<td>Systems and boundary value problems for ODEs</td>
</tr>
<tr>
<td>7</td>
<td>LU factorisation</td>
</tr>
<tr>
<td>8</td>
<td>Error analysis and QR factorisation</td>
</tr>
<tr>
<td>9</td>
<td>Householder and least squares</td>
</tr>
<tr>
<td>10</td>
<td>PDEs including classification and finite difference</td>
</tr>
<tr>
<td>11</td>
<td>PDEs including finite difference</td>
</tr>
<tr>
<td>12</td>
<td>PDEs</td>
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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.
Unit guide MATH3905 Methods for Mathematical Computation

- 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 since First Published

<table>
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<tr>
<th>Date</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>03/02/2023</td>
<td>Modified topics</td>
</tr>
<tr>
<td>24/01/2023</td>
<td>Added names</td>
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