



# MATH1020

## Calculus and Linear Algebra II

Session 1, Online-scheduled-weekday 2023

*School of Mathematical and Physical Sciences*

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## General Information

### Unit convenor and teaching staff

Convener/Lecturer

The Bui

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Contact via Email

Please refer to iLearn

Lecturer

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Please refer to iLearn

Credit points

10

Prerequisites

MATH1010 or MATH1015 or MATH132 or MATH135

Corequisites

Co-badged status

Unit description

The foundations of linear algebra and calculus introduced in MATH1010 are further explored and extended. Topics covered in algebra include: inverse matrices, determinants, vector spaces & subspaces, eigenvalues and eigenvectors and linear transformations. In calculus the topics include: the further development of the concepts of limits, continuity and the derivative, numerical integration, polynomials, sequences & series and differential equations. In addition, complex numbers and the calculus of two or more variables are introduced. Students utilise mathematical software throughout the course to support and enhance problem solving for a variety of theoretical and practical 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:** Apply matrix inversion and decomposition methods to determine solutions to systems of linear equations.

**ULO2:** Analyse vectors and linear maps in spaces of arbitrary dimension, developing concepts such as vector spaces and eigenspaces.

**ULO3:** Utilise complex numbers and techniques of differentiation and integration to determine and compare properties of single variable and multivariable functions.

**ULO4:** Analyse the convergence of a wide range of infinite series, including Taylor series.

**ULO5:** Evaluate problems from a wide variety of applications and apply appropriate algorithmic techniques to obtain solutions.

## General Assessment Information

### Requirements to Pass this Unit

To pass this unit you must: • Achieve a total mark equal to or greater than 50%, and • Participate in a minimum of 10 of the 12 weekly SGTA classes.

### Hurdle Assessments

#### Participation in SGTA classes (0%)

Development of knowledge and skills requires continual practice. During SGTAs you will practice a range of mathematical techniques. To pass this hurdle assessment, you must be able to demonstrate your progress in developing and communicating knowledge and skills in 10 of the 12 SGTAs. This is a hurdle assessment meaning that failure to meet this requirement may result in a fail grade for the unit. Students are permitted up to two absences: additional absences will require a Special Consideration to be applied for (see below).

#### 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 timesensitive 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

- Major Test 1 - NO, unless Special Consideration is Granted
- Major Test 2 - NO, unless Special Consideration is Granted
- Matlab Assignment - YES, Standard Late Penalty applies
- Weekly Quiz - NO, unless Special Consideration is Granted

- SGTA participation - NO, unless Special Consideration is Granted
- Final Examination - NO, unless Special Consideration is Granted

### Special Consideration

The Special Consideration Policy aims to support students who have been impacted by shortterm 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](http://ask.mq.edu.au). Participation in SGTA classes: To pass the unit you need to demonstrate ongoing development of skills and application of knowledge in 10 out of 12 of the weekly SGTA classes. If you miss a weekly SGTA class due to a serious, unavoidable and significant disruption, contact your convenor ASAP as you may be able to attend another class that week. If it is not possible to attend another class, you should still contact your convenor for access to class material to review in your own time. Note that a Special Consideration should only be applied for if you miss more than two of the weekly practical classes.

## Assessment Tasks

| Name  | Weighting | Hurdle | Due                           |
|---|-----------|--------|-------------------------------|
| <a href="#">Major Test 2</a>                  | 12%       | No     | Week 11                       |
| <a href="#">Weekly Quiz</a>                   | 16%       | No     | Weekly (from Week 2)          |
| <a href="#">Final examination</a>             | 50%       | No     | University Examination period |
| <a href="#">Participation in SGTA classes</a> | 0%        | Yes    | Weekly (from Week 2)          |
| <a href="#">Major Test 1</a>                  | 12%       | No     | Week 5                        |
| <a href="#">Matlab Assignm</a>                | 10%       | No     | Week 12                       |

### Major Test 2

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

Indicative Time on Task <sup>2</sup>: 7 hours

Due: **Week 11**

Weighting: **12%**

This will test the ability of students to analyse and solve mathematical problems using concepts and techniques in linear algebra and calculus.

On successful completion you will be able to:

- Apply matrix inversion and decomposition methods to determine solutions to systems of linear equations.
- Analyse vectors and linear maps in spaces of arbitrary dimension, developing concepts such as vector spaces and eigenspaces.
- Utilise complex numbers and techniques of differentiation and integration to determine and compare properties of single variable and multivariable functions.
- Analyse the convergence of a wide range of infinite series, including Taylor series.
- Evaluate problems from a wide variety of applications and apply appropriate algorithmic techniques to obtain solutions.

## Weekly Quiz

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

Indicative Time on Task <sup>2</sup>: 9 hours

Due: **Weekly (from Week 2)**

Weighting: **16%**

The subject will have nine weekly online (iLearn) quizzes containing one to three short questions. The quizzes will last for one hour, and be available for a duration of one week. The quizzes will not run in Week 1, or weeks containing a midterm test. Each quiz is worth 2%, with the best eight quizzes counted to the overall grade.

On successful completion you will be able to:

- Apply matrix inversion and decomposition methods to determine solutions to systems of linear equations.
- Analyse vectors and linear maps in spaces of arbitrary dimension, developing concepts such as vector spaces and eigenspaces.
- Utilise complex numbers and techniques of differentiation and integration to determine and compare properties of single variable and multivariable functions.
- Analyse the convergence of a wide range of infinite series, including Taylor series.
- Evaluate problems from a wide variety of applications and apply appropriate algorithmic techniques to obtain solutions.

## Final examination

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

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

Due: **University Examination period**

Weighting: **50%**

Held during the final 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:

- Apply matrix inversion and decomposition methods to determine solutions to systems of linear equations.
- Analyse vectors and linear maps in spaces of arbitrary dimension, developing concepts such as vector spaces and eigenspaces.
- Utilise complex numbers and techniques of differentiation and integration to determine and compare properties of single variable and multivariable functions.
- Analyse the convergence of a wide range of infinite series, including Taylor series.
- Evaluate problems from a wide variety of applications and apply appropriate algorithmic techniques to obtain solutions.

## Participation in SGTA classess

Assessment Type <sup>1</sup>: Practice-based task

Indicative Time on Task <sup>2</sup>: 0 hours

Due: **Weekly (from Week 2)**

Weighting: **0%**

**This is a hurdle assessment task (see [assessment policy](#) for more information on hurdle assessment tasks)**

Development of knowledge and skills requires continual practice. During SGTAs you will practice a range of mathematical techniques. To pass this hurdle assessment, you must be able to demonstrate your progress in developing and communicating knowledge and skills in 10 out of 12 SGTAs.

On successful completion you will be able to:

- Apply matrix inversion and decomposition methods to determine solutions to systems of linear equations.
- Analyse vectors and linear maps in spaces of arbitrary dimension, developing concepts such as vector spaces and eigenspaces.

- Utilise complex numbers and techniques of differentiation and integration to determine and compare properties of single variable and multivariable functions.
- Analyse the convergence of a wide range of infinite series, including Taylor series.
- Evaluate problems from a wide variety of applications and apply appropriate algorithmic techniques to obtain solutions.

## Major Test 1

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

Indicative Time on Task <sup>2</sup>: 7 hours

Due: **Week 5**

Weighting: **12%**

This will test the ability of students to analyse and solve mathematical problems using concepts and techniques in linear algebra and calculus.

On successful completion you will be able to:

- Apply matrix inversion and decomposition methods to determine solutions to systems of linear equations.
- Analyse vectors and linear maps in spaces of arbitrary dimension, developing concepts such as vector spaces and eigenspaces.
- Utilise complex numbers and techniques of differentiation and integration to determine and compare properties of single variable and multivariable functions.
- Analyse the convergence of a wide range of infinite series, including Taylor series.
- Evaluate problems from a wide variety of applications and apply appropriate algorithmic techniques to obtain solutions.

## Matlab Assignment

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

Indicative Time on Task <sup>2</sup>: 7 hours

Due: **Week 12**

Weighting: **10%**

The problem set will be aimed at further developing the ability to use Matlab to solve mathematical problems and perform mathematical operations. It will ask students to use Matlab to perform tasks such as solving linear systems, perform linear transformations, determine the values of series and integrals, and plot functions of more than one variable.

On successful completion you will be able to:

- Apply matrix inversion and decomposition methods to determine solutions to systems of linear equations.
- Analyse vectors and linear maps in spaces of arbitrary dimension, developing concepts such as vector spaces and eigenspaces.
- Utilise complex numbers and techniques of differentiation and integration to determine and compare properties of single variable and multivariable functions.
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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): Students must register in and attend one two-hour class per week. This is a hurdle requirement. Missing more than two SGTA classes will result in failure of the unit.

### Suggested textbooks

The following textbooks are useful as supplementary resources, for additional questions and explanations. They are available from the Macquarie University library:

- Algebra - *Lay*, Linear Algebra and its Applications.
- Calculus - *Stewart*, Calculus (Metric Version).

### 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/coronavirusfaq>. 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

### Unit Schedule

| Week |  | Assessment Due |
|------|--|----------------|
|      | <b>Stream 1 – Algebra</b>  |                |
| 1    | Matrices (Review), Vectors, Linear Combinations, Elementary Matrices               |                |
| 2    | Inverse Matrices, Matrices, LU Decomposition, Determinants                         |                |
| 3    | Linear Dependence, Vector Spaces & Subspaces, Bases                                |                |
| 4    | Dimension, Eigenvalues & Eigenvectors, Eigenspaces                                 |                |
| 5    | Diagonalisation, Linear Transformations  | Test 1         |
| 6    | Matrix of a Linear Transformations, Composition of Linear Transformations          |                |
|      | <b>Stream 2 – Calculus</b>   |                |
| 7    | Limits, Improper Integrals, Continuity   |                |
| 8    | IVT, Newton's Method, Rolle's Theorem, MVT, Numerical Integration, Complex Numbers |                |
| 9    | Argand Plane, Polar Form, De Moivre's Theorem, Polynomials                         |                |
| 10   | Polynomials, Taylor Polynomials, Infinite Series                                   |                |
| 11   | Functions of Several Variables, Partial Derivatives                                | Test 2         |
| 12   | Directional Derivatives, Extrema, 2nd order ODEs, Systems of ODEs                  | Assignment     |
|      | <i>Note: this schedule is provisional and may vary from the delivered content</i>  |                |

## 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](https://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.