



# MATH2010

## Calculus and Linear Algebra III

Session 1, Special circumstances 2021

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

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#### **Disclaimer**

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

#### **Notice**

As part of [Phase 3 of our return to campus plan](#), most units will now run tutorials, seminars and other small group activities on campus, and most will keep an online version available to those students unable to return or those who choose to continue their studies online.

To check the availability of face-to-face activities for your unit, please go to [timetable viewer](#). To check detailed information on unit assessments visit your unit's iLearn space or consult your unit convenor.

## General Information

Unit convenor and teaching staff

Unit convenor/Lecturer

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Please refer to iLearn

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Credit points

10

Prerequisites

MATH1020 or MATH1025 or MATH133 or MATH136 or WMAT1020 or WMAT136

Corequisites

Co-badged status

MATH2055 Engineering Mathematics II

### Unit description

The idea of a vector space first introduced in MATH1020 and MATH1025 is enriched in this unit by the introduction of an inner product. This leads to the important notion of orthogonality that underpins many areas of mathematics. The idea of linear transformations which transfer linearity from one space to another is also discussed. The results and techniques are then applied to problems such as approximation, quadratic forms and Fourier series. Differential and integral calculus involving functions of two real variables introduced in MATH1020 and MATH1025 are generalised to multivariable calculus including vector-valued functions, multivariable Taylor approximations, constrained optimization and multiple integrals in various coordinate systems. The ideas introduced in the unit are central to the development of many areas of modern areas of mathematics and to mathematical modelling of real world phenomena encounter in scientific and engineering 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:** Determine the rates of change of systems that vary over space and time and construct approximate representations for them (multi-variable Taylor series).

**ULO2:** Formulate and solve simple physical problems through the use of linear techniques.

**ULO3:** Develop multiple representations for a system and justify the best choice physically (eg. Fourier Series).

**ULO4:** Successfully communicate how the mathematical methods developed in the unit relate to real world systems.

## General Assessment Information

**HURDLES:** The mid-semester Test is a hurdle requirement. Details available on iLearn.

**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. You should upload this as a single scanned PDF file.

- 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 OF WORK:** All assessment tasks must be submitted by the official due date and time. In the case of a late submission for a non-timed assessment (e.g. an assignment), if special consideration has NOT been granted, 20% of the earned mark will be deducted for each 24-hour period (or part thereof) that the submission is late for the first 2 days (including weekends and/or public holidays). For example, if an assignment is submitted 25 hours late, its mark will attract a penalty equal to 40% of the earned mark. After 2 days (including weekends and public holidays) a mark of 0% will be awarded. Timed assessment tasks (e.g. tests, examinations) do not fall under these rules.

**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](http://ask.mq.edu.au).

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](http://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
<a href="#">Mid-semester Test</a>	20%	Yes	Week 5
<a href="#">Assignments</a>	30%	No	Weeks 7 and 12
<a href="#">Final exam</a>	50%	No	Exam period

### Mid-semester Test

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

Indicative Time on Task <sup>2</sup>: 6 hours

Due: **Week 5**

Weighting: **20%**

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

Online test; electronic submission

On successful completion you will be able to:

- Determine the rates of change of systems that vary over space and time and construct approximate representations for them (multi-variable Taylor series).
- Formulate and solve simple physical problems through the use of linear techniques.
- Develop multiple representations for a system and justify the best choice physically (eg. Fourier Series).
- Successfully communicate how the mathematical methods developed in the unit relate to real world systems.

### Assignments

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

Indicative Time on Task <sup>2</sup>: 12 hours

Due: **Weeks 7 and 12**

Weighting: **30%**

Two assignments (weighted at 15% each) submitted electronically

On successful completion you will be able to:

- Determine the rates of change of systems that vary over space and time and construct approximate representations for them (multi-variable Taylor series).
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- Develop multiple representations for a system and justify the best choice physically (eg. Fourier Series).
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## Final exam

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

Indicative Time on Task <sup>2</sup>: 12 hours

Due: **Exam period**

Weighting: **50%**

This will be an invigilated exam, 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:

- Determine the rates of change of systems that vary over space and time and construct approximate representations for them (multi-variable Taylor series).
- Formulate and solve simple physical problems through the use of linear techniques.
- Develop multiple representations for a system and justify the best choice physically (eg. Fourier Series).
- Successfully communicate how the mathematical methods developed in the unit relate to real world systems.

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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:** This course is delivered by two weekly online lectures (1 hour each) and one SGTA (1 hour), plus supplementary videos on iLearn. See the official timetable or iLearn page for more detail on class times.

The students should watch two one-hour lectures each week, plus supplementary videos and also register and participate in one one-hour SGTA class per week.

### Textbooks:

The required texts for MATH2010 are

- Anton & Rorres: [Elementary Linear Algebra](#), Applications Version , 11th Edition, Wiley 2014
- *Stewart*, Calculus (Metric Version), 8th edition.

Free electronic versions are available for Macquarie students. See details on iLearn.

Textbooks can be purchased online at [www.coop.com.au](http://www.coop.com.au) or from other places.

There are limited copies in the library.

## Unit Schedule

Week	Topic	Assessment Due
	<b>Stream 1 - Calculus</b>	
1	Euclidean spaces. Functions of many variables. Graphs of functions. Lines, planes and hyperplanes.	
2	Limits and continuity in one, two and higher dimensions. Arithmetic of limits. Polar coordinates.	
3	Partial derivatives. Directional derivatives and the gradient. Tangents to fibres and normal lines. Implicit differentiation and implicit function theorem.	
4	Multivariate differentiability. Arithmetic of differentiable functions. The chain rule.	
5	Second order partial derivatives. First and second order Taylor approximations. Local extrema. Constrained optimisation.	Mid-Semester Test
6	Multiple integrals. Change of variable for multiple integrals. Inverse function theorem.	
	<b>Stream 2 - Algebra</b>	
7	Systems of linear equations/row reduction; matrix inverse; brief introduction to linear transformations and linear operators (kernel, range); Introduction to vector spaces	Assignment 1
8	Change of basis; Linear transformations; matrices for linear transformations	

Week	Topic	Assessment Due
9	Kernel and range of linear transformation (cont'd); row space and column space; Eigenvalues and eigenspaces of linear transformations; matrices of linear transformations in different bases	
10	Similar matrices; diagonalisation; Inverse operators; inner product; Fourier Series, Gram-Schmidt	
11	Orthogonal and symmetric matrices; Quadratic forms; orthogonal projections	
12	Least squares approximations; pseudo-inverse; complex vector spaces	Assignment 2
<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](#)
- [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 \(https://students.mq.edu.au/support/study/policies\)](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)



## 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](http://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](http://ask.mq.edu.au)

If you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto: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/](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
11/02/2021	Updated Assessment order, Delivery and Resources section and unit schedule