MATH2010

Calculus and Linear Algebra III

Session 1, Online-scheduled-In person assessment 2025

School of Mathematical and Physical Sciences

Contents

General Information

Unit convenor and teaching staff
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Credit points
10

Prerequisites
MATH1020 or MATH1025 or WMAT1020

Corequisites

Co-badged status
Math 2055 - 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

Requirements to Pass This Unit

To pass this unit, you must

- Achieve a total mark equal to or greater than 50% across all assessments.

Attendance and participation

Regular engagement in all learning activities of the unit is crucial for your success. These activities provide opportunities to deepen your understanding of the material, collaborate with peers, and receive valuable feedback from instructors, to assist in completing the unit assessments. Your active participation not only enhances your own learning experience but also contributes to a vibrant and dynamic learning environment for everyone.

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. This grace period will be applied automatically, and no notification to unit staff is necessary. 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

- Assignment - YES, Standard Late Penalty applies
- Skills assessment - YES, Standard Late Penalty applies

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 connect.mq.edu.au.

Participation in SGTA classes: Special Consideration is not necessary for SGTA classes. However, 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.

Assessment Tasks

Name	Weighting	Hurdle	Due
Skills exercise	30%	No	06/06/2025
Final examination	50%	No	Exam Period
Assignment	20%	No	25/05/2025

Skills exercise

Assessment Type [1]: Practice-based task
Indicative Time on Task [2]: 18 hours
Due: **06/06/2025**
Weighting: **30%**

Exercises designed to develop and assess mathematical skills, reinforcing theoretical knowledge through consistent practice to promote mastery of essential concepts.

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.

Final examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 20 hours
Due: **Exam Period**
Weighting: **50%**

The exam will test the ability of students to utilise concepts and techniques learnt in the unit.

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.

Assignment

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 12 hours
Due: **25/05/2025**
Weighting: **20%**

The assignment will test the ability of students to solve mathematical problems using concepts and techniques learnt in the unit.

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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[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): Students should register in and attend one two-hour class per week.

Suggested textbooks

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

- Anton & Rorres, *Elementary Linear Algebra*, applications version, 11th edition, Wiley 2013. An electronic version is freely available to Macquarie students here.
- Stewart, *Calculus: Metric Version,* 8th edition, or Stewart, *Calculus: Early Transcendentals*, 8th edition. An electronic version is freely available to Macquarie students here

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.

Unit Schedule

WEEK	Topic	Task Due
	Stream 1 - Calculus	
1	Euclidean spaces. Functions of many variables. Graphs of functions. Lines, planes and hyperplanes.	
2	Limits and continuity in one and many variables. Arithmetic of limits. Polar coordinates.	
3	Partial derivatives, directional derivatives, and gradients for real-valued and vector-valued functions.	

4	Multivariate differentiability. Arithmetic of differentiable functions. The chain rule. Tangent and normals to level-sets.	
5	Second-order partial derivatives. Multivariate Taylor approximations. Finding local extrema. Constrained optimisation (Lagrange multipliers).	
6	Multiple integration. Fubini's theorem. Double integrals over irregular regions. Change of coordinates for multiple integrals.	
	Stream 2 - Algebra	
7	Systems of linear equations; vector spaces; subspaces; basis; dimension	
	MID SEMESTER BREAK	
8	Change of basis; linear transformations; matrices for linear transformations	
9	Kernel and range of linear transformation; column space; eigenvalues and eigenspaces of linear transformations; matrices of linear transformations in different bases	
10	Similar matrices, diagonalisation; inner product; norm; orthogonality; Fourier series	
11	Gram-Schmidt process, orthogonal and symmetric matrices, quadratic forms, orthogonal subspaces	Assignment
12	Orthogonal projections, least squares approximations, and complex vector spaces	
13	Revision.	Skills exercise

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 connect.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 Advocacy provides independent advice on MQ policies, procedures, and processes

Student Enquiries

Got a question? Ask us via the Service Connect Portal, 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 from Previous Offering

To enable students more time to focus on learning, understanding and reflecting on the content of our unit we have revised the assessment structure as follows. There are now only three assessments: a skills assessment, an assignment and a final exam. Although no marks are associated with attendance or participation, all activities of the unit are critical in order for you to understand content and complete the assessments.

Changes since First Published

Date	Description
09/02/2025	Correct assignment due dates

Unit information based on version 2025.04 of the Handbook