MATH2010

Calculus and Linear Algebra III

Session 2, Online-scheduled-weekday 2022

School of Mathematical and Physical Sciences

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General Information

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Credit points
10

Prerequisites
MATH1020 or MATH1025 or MATH133 or MATH136 or WMAT1020 or WMAT136

Corequisites

Co-badged status
MATH2055

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

Late Assessment Submission Penalty

From 1 July 2022, Students enrolled in Session based units with written assessments will have the following late penalty applied. Please see https://students.mq.edu.au/study/assessment-exams/assessments for more information.

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark) will be applied each day a written 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. Submission time for all written assessments is set at **11:55 pm**. A 1-hour grace period is 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, students need to submit an application for Special Consideration.

Assessments where Late Submissions will be accepted

In this unit, late submissions will accepted as follows:

- Assignment - YES, Standard Late Penalty applies
- Test 1 - NO, unless Special Consideration is granted
- Test 2 - NO, unless Special Consideration is granted
- Weekly Quizzes - NO, unless Special Consideration is granted
- SGTA Participation - NO, unless Special Consideration is granted

Assessment Tasks

Name	Weighting	Hurdle	Due
Test 2	12%	No	Week 11
Test 1	12%	No	Week 6
Weekly Quiz	16%	No	Weeks 2,3,4,5,7,8,9,10,12
Assignment	10%	No	Week 12
SGTA Participation	0%	Yes	Weekly (from Week 2)
Final exam	50%	No	University Examination Period

Test 2

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

- 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.

Test 1

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 7 hours
Due: **Week 6**
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:

- 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.

Weekly Quiz

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 9 hours
Due: **Weeks 2,3,4,5,7,8,9,10,12**
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:

- 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]: 7 hours
Due: **Week 12**
Weighting: **10%**

One assignment 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).
- 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.

SGTA Participation

Assessment Type [1]: Participatory task
Indicative Time on Task [2]: 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)

Students are expected to demonstrate their ability to engage with the unit by actively participating in SGTA classes.

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 exam

Assessment Type [1]: Examination
Indicative Time on Task [2]: 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:

- 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

Delivery and Resources

Classes: This course is delivered by two weekly lectures (1 hour each) and one SGTA (2 hours). See the official timetable or iLearn page for more detail on class times.

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

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

Textbooks:

The recommended 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 or from other places.

There are limited copies in the library.

Unit Schedule

Unit Schedule

Week	Topic	Assessment Due
	Stream 1 - Calculus	
1	Euclidean spaces; Functions of many variable;. Graphs of functions; Lines, planes and hyperplanes.	
2	Limits and continuity in one, two and higher dimensions; Arithmetic of limits; Polar coordinates.	
3	Partial derivative;. Directional derivatives and the gradient; Implicit differentiation and implicit function theorem; Vector-valued functions.	
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.	
6	Multiple integrals; Change of variable for multiple integrals; Inverse function theorem.	Test 1
	Stream 2 - Algebra	

Week	Topic	Assessment Due
7	Linear Systems, Vector spaces, Basis and dimension;	
8	Change of basis; Linear transformations; matrices for linear transformations.	
9	Range and kernel of linear transformation; Column space (or range) of a matrix; Eigenvalues and eigenspaces of linear transformations; Matrices of linear transformations in different bases.	
10	Similar matrices; Diagonalisation; Inner product; Norms; Orthogonality; Fourier Series.	
11	Gram-Schmidt process; Orthogonal matrices; Symmetric matrices; Quadratic forms.	Test 2
12	Orthogonal projections; Least squares approximations; Complex vector spaces.	Assignment
	Note: this schedule is provisional and may vary from the delivered content	

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.