MATH2010

Calculus and Linear Algebra III

Session 1, In person-scheduled-weekday, North Ryde 2022

School of Mathematical and Physical Sciences

Contents

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 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

ASSIGNMENT SUBMISSION: Assignment submission will be online through the iLearn page.

Submit the assignment 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 due date and time. In the case of a late submission of the assignment, where special consideration has NOT been granted, the following procedure will be followed:

A 12-hour grace period will be given after which the following deductions will be applied to the awarded assessment mark:

- 12 to 24 hours late = 10% deduction.
- For each day thereafter (including weekends and/or public holidays) an additional 10% per day or part thereof.
- Until five days beyond the due date; after this time, a mark of zero (0) will be given.

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.

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) 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
Test 2	12%	No	Week 11
Test 1	12%	No	Week 5
Weekly Quiz	16%	No	Weeks 2-12
Assignment	10%	No	Week 12
SGTA Participation	0%	Yes	Weeks 2-13
Final exam	50%	No	Final exam 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 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:

- 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).
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Weekly Quiz

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 9 hours
Due: **Weeks 2-12**
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.
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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).
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SGTA Participation

Assessment Type [1]: Participatory task
Indicative Time on Task [2]: 0 hours
Due: **Weeks 2-13**
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: **Final exam 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

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

Week	Topic	Assessment Due
	Stream 1 - Calculus	
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.	Test 1
6	Multiple integrals. Change of variable for multiple integrals. Inverse function theorem.	
	Stream 2 - Algebra	
7	Systems of linear equations/row reduction; matrix inverse; brief introduction to linear transformations and linear operators (kernel, range); Introduction to vector spaces	
8	Change of basis; Linear transformations; matrices for linear transformations	
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	Test 2
12	Least squares approximations; pseudo-inverse; complex vector spaces	Assignment 2
	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.