MATH2010

Calculus and Linear Algebra III

Session 2, Online-scheduled-In person assessment 2024

School of Mathematical and Physical Sciences

Contents

General Information

Unit convenor and teaching staff
Lecturer (algebra)
Bregje Pauwels
bregje.pauwels@mq.edu.au
Contact via Contact via email
12WW, 734
See iLearn

Lecturer (calculus)
Elena Vynogradova
elena.vynogradova@mq.edu.au
Contact via Contact via email
See iLearn

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

Requirements to Pass This Unit

To pass this unit, you must

- Achieve a total mark equal to or greater than 50%, and
- Participate in, and undertake all the Practice-based activities for a minimum of 10 of the 12 weekly SGTA.

Hurdle Assessments

Practice-based skills for 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

- Weekly quizzes – NO, unless Special Consideration is Granted
- Test 1 - NO, unless Special Consideration is Granted
- Test 2 - NO, unless Special Consideration is Granted
- Assignment - 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 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 practice-based tasks for 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
Participation in SGTA classess	0%	Yes	Weeks 2-13
Weekly Quiz	16%	No	Weeks 2-12 except for Test weeks
Test 1	12%	No	Week 5
Test 2	12%	No	Week 11
Assignment	10%	No	Week 12
Final exam	50%	No	Final exam period

Participation in SGTA classess

Assessment Type [1]: Practice-based 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)

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:

- 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 2-12 except for Test weeks**
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.

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).
- Successfully communicate how the mathematical methods developed in the unit relate to real world systems.

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.

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.

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.

---

[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 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:

- 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.	Week 2 quiz
3	Partial derivatives, directional derivatives, and gradients for real-valued and vector-valued functions.	Week 3 quiz
4	Multivariate differentiability. Arithmetic of differentiable functions. The chain rule. Tangent and normals to level-sets.	Week 4 quiz
5	Second-order partial derivatives. Multivariate Taylor approximations. Finding local extrema. Constrained optimisation (Lagrange multipliers).	Test 1
6	Multiple integration. Fubini's theorem. Double integrals over irregular regions. Change of coordinates for multiple integrals.	Week 6 quiz
	Stream 2 - Algebra	
7	Systems of linear equations; vector spaces; subspaces; basis; dimension	Week 7 quiz
8	Change of basis; linear transformations; matrices for linear transformations	Week 8 quiz
	MID SEMESTER BREAK	
9	Kernel and range of linear transformation; column space; eigenvalues and eigenspaces of linear transformations; matrices of linear transformations in different bases	Week 9 quiz
10	Similar matrices, diagonalisation; inner product; norm; orthogonality; Fourier series	Week 10 quiz
11	Gram-Schmidt process, orthogonal and symmetric matrices, quadratic forms, orthogonal subspaces	Test 2
12	Orthogonal projections, least squares approximations, and complex vector spaces	Assignment and Week 12 quiz
13	Revision.	

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 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/.

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

We value student feedback to be able to continually improve the way we offer our units. As such we encourage students to provide constructive feedback via student surveys, to the teaching staff directly, or via the FSE Student Experience & Feedback link in the iLearn page. Student feedback from the previous offering of this unit was very positive overall, with students pleased with the clarity around assessment requirements and the level of support from teaching staff. As such, no change to the delivery of the unit is planned, however we will continue to strive to improve the level of support and the level of student engagement.

Unit information based on version 2024.02 of the Handbook