# MATH235

## Mathematics IIA

S2 Evening 2014

*Mathematics*

## Contents

# General Information

Unit convenor and teaching staff
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Credit points
3

Prerequisites
MATH133 or MATH136

Corequisites

Co-badged status

Unit description
The idea of a vector space first introduced in MATH136 and MATH133 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 several real variables are discussed in greater depth than in MATH136 and MATH133. The ideas here are central to the development of mathematics in many different directions.

## 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:

Knowledge of the principles and concepts of a broad range of calculus in several variables, linear algebra over both the real and complex numbers, matrix theory, and properties of linear transformations.

Understanding of the breadth of the vector calculus and linear algebra, their role in other fields, and the way other fields contribute to the development of the mathematical sciences.

Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, especially concerning convergence in the setting of several variables and arguments involving bases in vector spaces.

Ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods

Application of mathematical principles, concepts, techniques and technology to solve practical and abstract problems

Appropriate interpretation of information communicated in mathematical form

Appropriate presentation of information, reasoning and conclusions in written form.

Ethical application of mathematical approaches to solving problems

Ability to work effectively, responsibly and safely in an individual or team context.

# Assessment Tasks

| Name | Weighting | Due |
|---|---|---|
| 5 Assignments | 20% | weeks 4, 6, 8, 10, and 12 |
| Exam | 60% | Exam period |
| One Test | 20% | Week 7 |
| Quizzes | 0% | Week 3 |

## 5 Assignments

Due: **weeks 4, 6, 8, 10, and 12**
Weighting: **20%**

Due in weeks 4, 6, 8, 10, and 12.

On successful completion you will be able to:

- Knowledge of the principles and concepts of a broad range of calculus in several variables, linear algebra over both the real and complex numbers, matrix theory, and properties of linear transformations.
- Understanding of the breadth of the vector calculus and linear algebra, their role in other fields, and the way other fields contribute to the development of the mathematical sciences.
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- Application of mathematical principles, concepts, techniques and technology to solve practical and abstract problems
- Appropriate interpretation of information communicated in mathematical form
- Appropriate presentation of information, reasoning and conclusions in written form.
- Ethical application of mathematical approaches to solving problems
- Ability to work effectively, responsibly and safely in an individual or team context.

## Exam

Due: **Exam period**
Weighting: **60%**

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On successful completion you will be able to:

- Knowledge of the principles and concepts of a broad range of calculus in several variables, linear algebra over both the real and complex numbers, matrix theory, and properties of linear transformations.
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- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, especially concerning convergence in the setting of several variables and arguments involving bases in vector spaces.
- Ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods
- Application of mathematical principles, concepts, techniques and technology to solve practical and abstract problems

- Appropriate interpretation of information communicated in mathematical form
- Appropriate presentation of information, reasoning and conclusions in written form.

## One Test

Due: **Week 7**
Weighting: **20%**

To be held in week 7.

On successful completion you will be able to:

- Knowledge of the principles and concepts of a broad range of calculus in several variables, linear algebra over both the real and complex numbers, matrix theory, and properties of linear transformations.
- Understanding of the breadth of the vector calculus and linear algebra, their role in other fields, and the way other fields contribute to the development of the mathematical sciences.
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, especially concerning convergence in the setting of several variables and arguments involving bases in vector spaces.
- Ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods
- Application of mathematical principles, concepts, techniques and technology to solve practical and abstract problems
- Appropriate interpretation of information communicated in mathematical form
- Appropriate presentation of information, reasoning and conclusions in written form.

## Quizzes

Due: **Week 3**
Weighting: **0%**

In order to obtain a passing grade in this unit, students are required to demonstrate their mastery of the required basic skills and techniques by passing both on-line quizzes. Students who do not meet this requirement will have their grade capped at F 49.

On successful completion you will be able to:

- Knowledge of the principles and concepts of a broad range of calculus in several variables, linear algebra over both the real and complex numbers, matrix theory, and properties of linear transformations.
- Understanding of the breadth of the vector calculus and linear algebra, their role in other

fields, and the way other fields contribute to the development of the mathematical sciences.

- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, especially concerning convergence in the setting of several variables and arguments involving bases in vector spaces.
- Ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods
- Application of mathematical principles, concepts, techniques and technology to solve practical and abstract problems

# Delivery and Resources

The required text for MATH235 is available for download on

- Multivariable and Vector Analysis by W.W.L Chen
- Linear Algebra by W.W.L Chen

You should download and study these. The online notes are intended primarily as a source of reference. These are not intended to be treated as the only source for learning. The following texts provide useful references for various sections of the course:

- Anton & Rorres; Elementary Linear Algebra: Applications version, 11th edition
- Lay; Linear Algebra and its Applications, 3rd edition
- Marsden & Tromba; Vector Calculus, 5th edition

Other similar texts are available in the Library.

# Unit Schedule

| Week | Algebra | Calculus |
|---|---|---|
| 1 | Complex linear algebra | Sets and functions. Euclidean spaces. |
| 2 | Transformations in Euclidean spaces | Continuity and limits. |
| 3 | Finite-dimensional vector spaces and linear transformations | Continuity and limits. |
| 4 | Basis and dimension. Rank-nullity theorem. | Directional and partial derivatives. Derivatives. |
| 5 | Eigenvalues and eigenvectors. | Directional and partial derivatives. Derivatives. |
| 6 | Real inner product spaces. | Derivatives of vector-valued functions. |
| 7 | Gram-Schmidt orthogonalization process. Orthonal projections. | The inverse function theorem. |
| 8 | Gram-Schmidt orthogonalization process. Orthonal projections. | The implicit function theorem |

| | | |
|---|---|---|
| 9 | Change of basis in inner product spaces | Critical points & extrema. |
| 10 | Orthonormal diagonalization | Lagrange multipliers. |
| 11 | Applications of real inner product spaces | Multiple integrals. |
| 12 | Complex inner product spaces | Multiple integrals: Fubini's theorem and change of variables |
| 13 | Revision | Revision |

# Learning and Teaching Activities

## Lectures

Four hours of lectures per week

## Tutorials

One hour per week

# Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

## Late Assignments

No extensions will be granted. Students who have not submitted the task prior to the deadline will be awarded a mark of 0 for the task, except for cases in which an application for special

consideration is made and approved.

## Electronic quizzes

In order to obtain a passing grade in this unit, students are required to demonstrate their mastery of the required basic skills and techniques by passing both on-line quizzes. Students who do not meet this requirement will have their grade capped at F 49.

## 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) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

## 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

## IT Help

For help with University computer systems and technology, visit http://informatics.mq.edu.au/help/.

When using the University's IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students.

# Graduate Capabilities

## Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing

environments.

This graduate capability is supported by:

## Learning outcomes

- Understanding of the breadth of the vector calculus and linear algebra, their role in other fields, and the way other fields contribute to the development of the mathematical sciences.
- Application of mathematical principles, concepts, techniques and technology to solve practical and abstract problems
- Appropriate interpretation of information communicated in mathematical form
- Appropriate presentation of information, reasoning and conclusions in written form.
- Ethical application of mathematical approaches to solving problems

## Assessment task

- 5 Assignments

# Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

## Learning outcomes

- Knowledge of the principles and concepts of a broad range of calculus in several variables, linear algebra over both the real and complex numbers, matrix theory, and properties of linear transformations.
- Ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods
- Application of mathematical principles, concepts, techniques and technology to solve practical and abstract problems

## Assessment tasks

- 5 Assignments
- Exam
- One Test

- Quizzes

## Learning and teaching activities

- Four hours of lectures per week
- One hour per week

# Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

## Learning outcomes

- Knowledge of the principles and concepts of a broad range of calculus in several variables, linear algebra over both the real and complex numbers, matrix theory, and properties of linear transformations.
- Understanding of the breadth of the vector calculus and linear algebra, their role in other fields, and the way other fields contribute to the development of the mathematical sciences.
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## Assessment tasks

- 5 Assignments
- Exam
- One Test
- Quizzes

## Learning and teaching activities

- Four hours of lectures per week

- One hour per week

## Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

### Learning outcomes

- Understanding of the breadth of the vector calculus and linear algebra, their role in other fields, and the way other fields contribute to the development of the mathematical sciences.
- Ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods
- Application of mathematical principles, concepts, techniques and technology to solve practical and abstract problems

### Assessment tasks

- 5 Assignments
- Exam
- One Test
- Quizzes

### Learning and teaching activities

- Four hours of lectures per week
- One hour per week

## Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

### Learning outcomes

- Understanding of the breadth of the vector calculus and linear algebra, their role in other fields, and the way other fields contribute to the development of the mathematical sciences.

- Ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods

## Assessment tasks

- 5 Assignments
- Exam
- One Test

## Learning and teaching activities

- Four hours of lectures per week
- One hour per week

# Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

## Learning outcomes

- Understanding of the breadth of the vector calculus and linear algebra, their role in other fields, and the way other fields contribute to the development of the mathematical sciences.
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, especially concerning convergence in the setting of several variables and arguments involving bases in vector spaces.
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- Ability to work effectively, responsibly and safely in an individual or team context.

## Assessment tasks

- 5 Assignments
- Exam
- One Test

## Learning and teaching activities

- Four hours of lectures per week
- One hour per week

## Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

### Learning outcome

- Ethical application of mathematical approaches to solving problems

## Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

### Learning outcome

- Ability to work effectively, responsibly and safely in an individual or team context.

# Extra requirements

In order to obtain a passing grade in this unit, students are required to demonstrate their mastery of the required basic skills and techniques by passing both on-line quizzes. Students who do not meet this requirement will have their grade capped at F 49.

Satisfactory performance on supervised assessment tasks, such as tests and the final exam, is necessary to pass this unit. If there is a significant difference between a student's marks on supervised assessment tasks and on unsupervised assessment tasks, the scaling of these tasks may be adjusted when determining the final grade, to reflect more appropriately that student's performance on supervised tasks.