MATH133

Mathematics IB (Advanced)

S2 Day 2014

Mathematics

Contents

General Information

Unit convenor and teaching staff
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Credit points
3

Prerequisites
MATH132 or MATH135(HD)

Corequisites

Co-badged status

Unit description
The notion of linearity is developed in this unit through the introduction of the abstract notion of vector spaces. The new ideas are then used to further study systems of linear equations. The unit also covers an introduction to group theory, one of the most fundamental concepts in modern mathematics. The study of differential and integral calculus is taken further by the introduction of functions of two real variables and the study of first-order and second-order ordinary differential equations. The notion of a limit is enhanced by the study of sequences and series. Ideas from power series are then used to revisit differential equations. The topics in this unit are studied with a degree of rigour and sophistication appropriate to better prepared students with a strong interest in the theoretical underpinnings of the subject. An alternative treatment of the same material from a less sophisticated point of view can be obtained by taking MATH136.

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 infinite series, partial derivatives, ordinary differential equations, vector spaces, linear transformations, matrix theory, and eigenvectors.
Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences. In particular, applications of differential equations and linear algebra in other fields.
Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, including arguments concerning convergence and linear independence.
Ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods including models based on ordinary differential equations and linear systems.
Application of mathematical principles, concepts, techniques and technology to solve practical and abstract problems.
Appropriate interpretation of information communicated in mathematical form. In particular, interpreting the solutions of ordinary differential equations and linear systems.
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
Five assignments	20%	Week 4, 6, 8, 10, 12
Two Tests	20%	Week 7, 11
Final examination	60%	University Examination Period

Five assignments

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

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On successful completion you will be able to:

- Knowledge of the principles and concepts of infinite series, partial derivatives, ordinary differential equations, vector spaces, linear transformations, matrix theory, and eigenvectors.
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- Ethical application of mathematical approaches to solving problems
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Two Tests

Due: **Week 7, 11**
Weighting: **20%**

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On successful completion you will be able to:

- Knowledge of the principles and concepts of infinite series, partial derivatives, ordinary differential equations, vector spaces, linear transformations, matrix theory, and eigenvectors.
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linear systems.
- Application of mathematical principles, concepts, techniques and technology to solve practical and abstract problems.
- Appropriate interpretation of information communicated in mathematical form. In particular, interpreting the solutions of ordinary differential equations and linear systems.

Final examination

Due: **University Examination Period**
Weighting: **60%**

-
On successful completion you will be able to:
- Knowledge of the principles and concepts of infinite series, partial derivatives, ordinary differential equations, vector spaces, linear transformations, matrix theory, and eigenvectors.
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Delivery and Resources

Classes

Lectures: you should attend two hours of each lecture stream each week, making a total of four hours.

Tutorials: you should attend one tutorial each week.

Required and Recommended Texts and/or Materials

The required text for MATH133 is available for download on

- *First Year Calculus* by W.W.L Chen
- *Linear Algebra* by W.W.L Chen
- *Miscellaneous Topics in First Year Mathematics* 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 same material is covered in many texts. You should try several of these, adopting one which suits your personal style of learning.

More notes on elementary topics are available at:

- *Elementary Mathematics* by W.W.L Chen

The following texts are recommended for this unit, and are available from the CO-OP Bookshop on campus, and are in the reference section of the Library.

- Stewart; *Calculus*
- Trim: *Calculus*
- Anton and Rorres: *Linear Algebra and its Applications*
- David C. Lay; *Linear Algebra and its Applications,*

Other similar texts are available in the Library, and for reference in the Numeracy Centre (C5A 225).

Additional notes Notes for Markov chains

http://www.sosmath.com/matrix/markov/markov.html http://aix1.uottawa.ca/~jkhoury/markov.htm Most books on linear algebra with applications will cover Markov chains. Some references have the columns summing to 1, others have the rows summing to 1 (depending on which way the state table is constructed). We will adopt the convention that the future state is on the vertical axis, so the columns sum to 1.

Orthogonality and least squares

These are covered in Chapter 6 of Lay. They are also in most texts on Linear Algebra, so you will find plenty of reference material in the Library and the Numeracy Centre.

Technology Used and Required

Students are expected to have access to an internet enabled computer with a web browser and Adobe Reader software. Several areas of the university provide wireless access for portable computers. There are computers for student use in the Library and in the Numeracy Centre (C5A 255).

Difficulties with your home computer or internet connection do not constitute a reasonable excuse for lateness of, or failure to submit, assessment tasks.

Unit Schedule

WEEK	ALGEBRA	CALCULUS	TASK DUE
1	Vector spaces	Sequences and series, convergence of sequences	
2		Convergence Tests of series	
3		Power series	
4	Vector spaces associated with matrices	Taylor series	Assignment 1
5		Functions of several real variables, Limits	
6	Eigenvectors, eigenvalues, diagonalization	Continuity, partial derivatives	Assignment 2
7	Systems of linear differential equations	Tangent planes, chain rule	Test 1
	MID-SEMESTER BREAK		
8	Discrete dynamical systems	Maxima and minima, Lagrange multipliers	Assignment 3
9		First order ordinary differential equations	
10	Orthogonality, projection	Applications of first order ordinary differential equations	Assignment 4
11	Least squares fitting	Higher order ordinary differential equations	Test 2
12	Quadratic forms	Applications of ordinary differential equations	Assignment 5
13	Revision	Revision	

Learning and Teaching Activities

Lectures

4 one hour lectures per week

Tutorial

1 one hour tutorial 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.

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

- Knowledge of the principles and concepts of infinite series, partial derivatives, ordinary differential equations, vector spaces, linear transformations, matrix theory, and eigenvectors.
- Application of mathematical principles, concepts, techniques and technology to solve practical and abstract problems.
- 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 task

- Five 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

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Assessment tasks

- Five assignments
- Two Tests
- Final examination

Learning and teaching activities

- 4 one hour lectures per week
- 1 one hour tutorial 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 infinite series, partial derivatives, ordinary differential equations, vector spaces, linear transformations, matrix theory, and eigenvectors.
- Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences. In particular, applications of differential equations and linear algebra in other fields.
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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

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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

- Knowledge of the principles and concepts of infinite series, partial derivatives, ordinary differential equations, vector spaces, linear transformations, matrix theory, and eigenvectors.
- Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences. In particular, applications of differential equations and linear algebra in other fields.
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Assessment tasks

- Five assignments
- Two Tests
- Final examination

Learning and teaching activities

- 4 one hour lectures per week
- 1 one hour tutorial 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

- Knowledge of the principles and concepts of infinite series, partial derivatives, ordinary differential equations, vector spaces, linear transformations, matrix theory, and eigenvectors.
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning, including arguments concerning convergence and linear independence.
- Ability to formulate and model practical and abstract problems in mathematical terms using a variety of methods including models based on ordinary differential equations and linear systems.
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Assessment tasks

- Five assignments
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Learning and teaching activities

- 4 one hour lectures per week
- 1 one hour tutorial 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 outcomes

- Knowledge of the principles and concepts of infinite series, partial derivatives, ordinary differential equations, vector spaces, linear transformations, matrix theory, and eigenvectors.
- Understanding of the breadth of the discipline, its role in other fields, and the way other fields contribute to the development of the mathematical sciences. In particular, applications of differential equations and linear algebra in other fields.
- Ethical application of mathematical approaches to solving problems
- Ability to work effectively, responsibly and safely in an individual or team context.

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 outcomes

- Knowledge of the principles and concepts of infinite series, partial derivatives, ordinary differential equations, vector spaces, linear transformations, matrix theory, and eigenvectors.
- Ability to work effectively, responsibly and safely in an individual or team context.

Extra requirements

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.

Changes since First Published

Date	Description
28/02/2014	The Description was updated.