



MATH133

Mathematics IB (Advanced)

S2 Day 2019

Dept of Mathematics and Statistics

Contents

<u>General Information</u>	2
<u>Learning Outcomes</u>	3
<u>General Assessment Information</u>	3
<u>Assessment Tasks</u>	5
<u>Delivery and Resources</u>	9
<u>Unit Schedule</u>	10
<u>Policies and Procedures</u>	11
<u>Graduate Capabilities</u>	12

Disclaimer

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

General Information

Unit convenor and teaching staff

Lecturer/Convenor

Michael Batanin

michael.batanin@mq.edu.au

Contact via Email

12 Wally's Walk 706

Monday 14-15

Lecturer

Frank Valckenborgh

frank.valckenborgh@mq.edu.au

Contact via Email

12 Wally's Walk 613

Friday 11-12

Frank Schoenig

frank.schoenig@mq.edu.au

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 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.

General Assessment Information

HURDLES: From week 2, participation in a weekly Small Group Teaching Activity (SGTA) is **compulsory**. Participation will be assessed by observation of students' work during classes or through submission of work completed during the SGTA. Participation and reasonable engagement in the class activities in at least 10 out of 12 SGTA's are requirements to pass the unit. This is a hurdle requirement.

ATTENDANCE and PARTICIPATION: Please contact the unit convenor as soon as possible if you have difficulty attending and participating in any classes. There may be alternatives available to make up the work. If there are circumstances that mean you miss a class, you can apply for a [Special Consideration](#).

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

Submit assignments 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 assignments or assessments must be submitted by the official due date and time. No marks will be given to late work unless an extension has been granted following a successful application for [Special Consideration](#). Please contact the unit convenor for advice as soon as you become aware that you may have difficulty meeting any of the assignment deadlines. It is in your interests to make frequent submissions of your partially completed work. Note that later submissions completely replace any earlier submission, and so only the final submission made before the due date will be marked.

FINAL EXAM POLICY: 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.

SUPPLEMENTARY EXAMINATIONS:

IMPORTANT: 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. If you apply for special consideration, you must give the supplementary examination priority over any other pre-existing commitments, as such commitments will not usually be considered an acceptable basis for a second application for special consideration. 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 (<https://bit.ly/FSESupp>) for dates, and approved applicants will receive an individual notification sometime in the week prior to the exam with the exact date and time of their supplementary examination.

Assessment Tasks

Name	Weighting	Hurdle	Due
SGTA Participation	0%	Yes	weekly
Assignment 1	15%	No	Week 7
Test 1	10%	No	Week 8
Assignment 2	15%	No	Week 11
Final examination	60%	No	University Examination Period

SGTA Participation

Due: **weekly**

Weighting: **0%**

This is a hurdle assessment task (see [assessment policy](#) for more information on hurdle assessment tasks)

From week 2, participation will be assessed by observation of students' work during classes or through submission of work completed during the SGTA. Participation and reasonable engagement in the class activities in at least 10 out of 12 SGTA's are required to pass the unit. This is a hurdle requirement.

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.
- 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.

Assignment 1

Due: **Week 7**

Weighting: **15%**

Assignment 1 is due in week 7 (see iLearn for more information).

Assignment submission will be online through the iLearn page.

Submit assignments online via the appropriate assignment link on iLearn. 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.

All assignments or assessments must be submitted by the official due date and time. No marks will be given to late work unless an extension has been granted following a successful application for [Special Consideration](#). Please contact the unit convenor for advice as soon as you become aware that you may have difficulty meeting any of the assignment deadlines. It is in your interests to make frequent submissions of your partially completed work. Note that later submissions completely replace any earlier submission, and so only the final submission made before the due date will be marked.

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.
- 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.

Test 1

Due: **Week 8**

Weighting: **10%**

The Mid-Term Test will be 45 minutes. Calculators without an alphanumeric keypad are allowed in class tests and the final exam.

The Mid-term test will cover material presented in lectures and SGTA's from Week 1 to Week 7 inclusive. It will be held in SGTA's in Week 8.

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.
- 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.

Assignment 2

Due: **Week 11**

Weighting: **15%**

Assignment 2 is due in week 11 (see iLearn for more information).

Assignment submission will be online through the iLearn page.

Submit assignments online via the appropriate assignment link on iLearn. 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.

All assignments or assessments must be submitted by the official due date and time. No marks will be given to late work unless an extension has been granted following a successful application for Special Consideration. Please contact the unit convenor for advice as soon as you become aware that you may have difficulty meeting any of the assignment deadlines. It is in your interests to make frequent submissions of your partially completed work. Note that later submissions completely replace any earlier submission, and so only the final submission made before the due date will be marked.

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.
- 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.

Final examination

Due: **University Examination Period**

Weighting: **60%**

Final Exam covering all course material.

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.
- 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.

Delivery and Resources

Classes

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

Small Group Teaching Activity (SGTA): You should attend and participate in one SGTA each week, starting from week 2. Participation in a weekly SGTA is compulsory and a hurdle requirement. Students have to participate in the SGTA in which they are enrolled. Any variation to this has to be approved by the Unit Convenor.

Required and Recommended Texts and/or Materials

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.

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.

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.

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

The following table gives an approximate timetable for the topics covered week-by-week

WEEK	ALGEBRA	CALCULUS
1	Vector spaces (Introduction, proofs, subspaces)	Sequences and series, convergence of sequences
2	Vector spaces (Span, Linear Independence)	Convergence Tests of series
3	Vector spaces (Basis, Dimension)	Power series
4	Vector spaces associated with matrices	Taylor series
5	Vector spaces associated with matrices	Functions of several real variables, Limits
6	Orthogonality	Continuity, partial derivatives
7	Projections, Least Squares	Tangent planes, chain rule
	MID-SEMESTER BREAK	
8	Eigenvectors and Eigenvalues	Maxima and minima, Lagrange multipliers

WEEK	ALGEBRA	CALCULUS
9	Diagonalization	First order ordinary differential equations
10	Applications: Markov Chains, Discrete Dynamical Systems	Applications of first order ordinary differential equations
11	Applications: Systems of linear differential equations	Higher order ordinary differential equations
12	Applications: Quadratic Forms	Applications of ordinary differential equations
13	Revision	Revision

Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). 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](#)
- [Grade Appeal Policy](#)
- [Complaint Management Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#) (**Note:** *The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.*)

Undergraduate students seeking more policy resources can visit the [Student Policy Gateway \(https://students.mq.edu.au/support/study/student-policy-gateway\)](https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit [Policy Central \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/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/study/getting-started/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

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

If you are a Global MBA student contact globalmba.support@mq.edu.au

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.

Graduate Capabilities

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

Assessment tasks

- SGTA Participation
- Assignment 1
- Test 1
- Assignment 2
- Final examination

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 tasks

- SGTA Participation
- Assignment 1
- Test 1
- Assignment 2
- Final examination

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Assessment task

- SGTA Participation

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 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.

Assessment tasks

- SGTA Participation
- Assignment 1
- Test 1
- Assignment 2
- Final examination

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.
- 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.

Assessment tasks

- SGTA Participation
- Assignment 1
- Test 1
- Assignment 2
- Final examination

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

- 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 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

- SGTA Participation
- Assignment 1
- Test 1
- Assignment 2
- Final examination

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.
- 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

- SGTA Participation
- Assignment 1
- Test 1
- Assignment 2
- Final examination

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.

Assessment tasks

- SGTA Participation
- Assignment 1
- Test 1
- Assignment 2

- Final examination

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.

Assessment tasks

- SGTA Participation
- Assignment 1
- Test 1
- Assignment 2
- Final examination