# MATH132

## Mathematics IA (Advanced)

**S1 Day 2016**

*Dept of Mathematics*

## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Information</td>
<td>2</td>
</tr>
<tr>
<td>Learning Outcomes</td>
<td>3</td>
</tr>
<tr>
<td>Assessment Tasks</td>
<td>4</td>
</tr>
<tr>
<td>Delivery and Resources</td>
<td>6</td>
</tr>
<tr>
<td>Unit Schedule</td>
<td>7</td>
</tr>
<tr>
<td>Learning and Teaching Activities</td>
<td>8</td>
</tr>
<tr>
<td>Policies and Procedures</td>
<td>8</td>
</tr>
<tr>
<td>Graduate Capabilities</td>
<td>9</td>
</tr>
<tr>
<td>Extra Requirements</td>
<td>13</td>
</tr>
<tr>
<td>Changes since First Published</td>
<td>13</td>
</tr>
</tbody>
</table>

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General Information

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Credit points
3

Prerequisites
(HSC Mathematics Extension 1 Band E3-E4 or Extension 2) or admission to BSc in Advanced Mathematics or BAdvSc or BActStud

Corequisites

Co-badged status
Unit description
This is the first mainstream mathematics unit for students who have entered the university with a strong background in mathematics. It is highly recommended for students with a serious interest in science and technology, and recommended for students in many other areas who wish to develop their mathematical knowledge with attention to the detail required for a rigorous development of the subject. Apart from some brief discussion on complex numbers and congruences, the main topic in the algebra half of this unit concerns linearity and the interplay between algebra and geometry. Plane geometry is first used to motivate the study of systems of linear equations. Algebraic techniques involving matrices and determinants are then developed to study these problems further. The algebraic machinery developed is then used to study geometrical problems in three-dimensional space. The notion of a limit is developed to a more sophisticated level than in secondary school mathematics, and this is used to study the differential and integral calculus involving functions of one real variable to a far greater depth than before. Some numerical techniques for integration are also discussed. Students who do not have the required background for this unit can take MATH135 which studies the same material, but from a less sophisticated standpoint.

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](https://www.mq.edu.au/study/calendar-of-dates)

Learning Outcomes
On successful completion of this unit, you will be able to:

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning. In particular, the ability to use limits and other infinite processes correctly.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using methods from calculus and linear algebra.
- Be able to apply the principles, concepts, and techniques learned in this unit to solve practical and abstract problems.
- Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions.
- Be able to present reasoning and conclusions informed by analysis involving calculus.
and linear algebra, in a variety of modes, to diverse audiences (expert and non-expert). Ethical application of mathematical approaches to solving problems and appropriately reference and acknowledge sources in an mathematical context. Be able to work effectively, responsibly and safely in an individual or team context.

Assessment Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Five assignments</td>
<td>20%</td>
<td>See ilearn.</td>
</tr>
<tr>
<td>Two Tests</td>
<td>20%</td>
<td>See ilearn.</td>
</tr>
<tr>
<td>Final examination</td>
<td>60%</td>
<td>University Examination Period</td>
</tr>
</tbody>
</table>

Five assignments

Due: See ilearn.
Weighting: 20%

See announcements in ilearn for the assignment exercises.

On successful completion you will be able to:

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning. In particular, the ability to use limits and other infinite processes correctly.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using methods from calculus and linear algebra.
- Be able to apply the principles, concepts, and techniques learned in this unit to solve practical and abstract problems.
- Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions.
- Be able to present reasoning and conclusions informed by analysis involving calculus and linear algebra, in a variety of modes, to diverse audiences (expert and non-expert).
- Ethical application of mathematical approaches to solving problems and appropriately
reference and acknowledge sources in a mathematical context.

• Be able to work effectively, responsibly and safely in an individual or team context.

Two Tests
Due: See iLearn.
Weighting: 20%
Tests will be held in tutorials.

On successful completion you will be able to:

• Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.

• Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.

• Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning. In particular, the ability to use limits and other infinite processes correctly.

• Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using methods from calculus and linear algebra.

• Be able to apply the principles, concepts, and techniques learned in this unit to solve practical and abstract problems.

• Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions.

• Be able to present reasoning and conclusions informed by analysis involving calculus and linear algebra, in a variety of modes, to diverse audiences (expert and non-expert).

Final examination
Due: University Examination Period
Weighting: 60%
Supervised by Academic Programme Section.

On successful completion you will be able to:

• Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.

• Present a broad outline of the scope of linear algebra and calculus, their roles in other
fields, and the way other fields contribute to their development.

• Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning. In particular, the ability to use limits and other infinite processes correctly.

• Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using methods from calculus and linear algebra.

• Be able to apply the principles, concepts, and techniques learned in this unit to solve practical and abstract problems.

• Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions.

• Be able to present reasoning and conclusions informed by analysis involving calculus and linear algebra, in a variety of modes, to diverse audiences (expert and non-expert).

**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 MATH132 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*
- Anton: *Linear Algebra and its Applications*
Other similar texts are available in the Library, and for reference in the Numeracy Centre (C5A 225).

**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**

<table>
<thead>
<tr>
<th>Week</th>
<th>Algebra</th>
<th>Calculus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Complex numbers: definitions, basic operations, equations with complex roots</td>
<td>The real numbers.</td>
</tr>
<tr>
<td>2</td>
<td>Complex numbers: modulus-argument form, De Moivre theorem, locus and regions in the complex plane</td>
<td>Mathematical Induction.</td>
</tr>
<tr>
<td>3</td>
<td>Polynomials: remainder theorem, factor theorem, rational roots</td>
<td>Limit of sequence, Functions</td>
</tr>
<tr>
<td>4</td>
<td>Polynomials: multiple roots, complex roots, relation between roots and coefficients</td>
<td>Limit of functions</td>
</tr>
<tr>
<td>5</td>
<td>Linear equations, solving systems of linear equations</td>
<td>Continuity, derivative</td>
</tr>
<tr>
<td>6</td>
<td>Applications of network flow, electrical networks, economics and chemistry</td>
<td>Properties of derivative</td>
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<tr>
<td></td>
<td>recess</td>
<td>recess</td>
</tr>
<tr>
<td>7</td>
<td>Matrices and basic properties</td>
<td>Differential</td>
</tr>
<tr>
<td>8</td>
<td>Applications of matrices</td>
<td>Mean value theorem</td>
</tr>
<tr>
<td>9</td>
<td>Determinants: definition and basic properties</td>
<td>Antiderivative</td>
</tr>
<tr>
<td>10</td>
<td>Applications of determinants</td>
<td>Integration</td>
</tr>
<tr>
<td>11</td>
<td>Vectors in 2 and 3 dimensions, inner product, cross product</td>
<td>Fundamental theorem of calculus</td>
</tr>
<tr>
<td>12</td>
<td>Applications of vectors</td>
<td>Applications of definite integrals</td>
</tr>
<tr>
<td>13</td>
<td>Revision</td>
<td>Revision</td>
</tr>
</tbody>
</table>
Learning and Teaching Activities

Lectures
4 hours of lectures per week, 2 in algebra, 2 in calculus.

Tutorial
One hour of 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


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/

Results
Results shown in iLearn, 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.

Student Support
Macquarie University provides a range of support services for students. For details, visit http://stu
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**

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using methods from calculus and linear algebra.
- Be able to apply the principles, concepts, and techniques learned in this unit to solve practical and abstract problems.
Assessment tasks

• Five assignments
• 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

• Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning. In particular, the ability to use limits and other infinite processes correctly.
• Ethical application of mathematical approaches to solving problems and appropriately reference and acknowledge sources in an mathematical context.
• Be able to work effectively, responsibly and safely in an individual or team context.

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

• Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
• Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
• Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using methods from calculus and linear algebra.
• Be able to apply the principles, concepts, and techniques learned in this unit to solve
practical and abstract problems.

- Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions.

**Assessment tasks**

- Five assignments
- Two Tests
- 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**

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
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- Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions.

**Assessment tasks**

- Five assignments
- Two Tests
- 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**

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using methods from calculus and linear algebra.
- Be able to apply the principles, concepts, and techniques learned in this unit to solve practical and abstract problems.

**Assessment tasks**

- Five assignments
- Two Tests
- 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**

- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning. In particular, the ability to use limits and other infinite processes correctly.
- Be able to present reasoning and conclusions informed by analysis involving calculus and linear algebra, in a variety of modes, to diverse audiences (expert and non-expert).

**Assessment tasks**

- Five assignments
- Two Tests
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

- Ethical application of mathematical approaches to solving problems and appropriately reference and acknowledge sources in an mathematical context.
- Be able to work effectively, responsibly and safely in an individual or team context.

Assessment task

- Five assignments

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

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
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<tbody>
<tr>
<td>02/03/2016</td>
<td>Corrected broken links to William Chen's notes</td>
</tr>
</tbody>
</table>