



# MATH3909

## Real and Functional Analysis

Session 2, In person-scheduled-weekday, North Ryde 2022

*School of Mathematical and Physical Sciences*

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## General Information

Unit convenor and teaching staff

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Credit points

10

Prerequisites

((MATH2010 or MATH235) and (MATH2020 or MATH236)) or MATH3901 or MATH3902 or MATH3905 or MATH3906 or MATH331 or MATH332 or MATH335 or MATH336

Corequisites

Co-badged status

Unit description

This unit is concerned with a review of the limiting processes of real analysis and an introduction to functional analysis. Through the discussion of such abstract notions as metric spaces, normed vector spaces and inner product spaces, we can appreciate an elegant and powerful combination of ideas from analysis and linear algebra.

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

## Learning Outcomes

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

**ULO1:** demonstrate a well- developed knowledge of the principles, concepts and techniques of a broad range of areas in analysis and applied mathematics, with significant depth in analysis and functional analysis.

**ULO2:** demonstrate an understanding of the breadth of mathematics, the multi-disciplinary role of mathematics and the way it contributes the development in other related fields of study.

**ULO3:** construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.

**ULO4:** formulate and model practical and abstract problems in mathematical terms using a variety of methods drawn from analysis and functional analysis.

**ULO5:** apply mathematical principles, concepts, techniques and technology efficiently to solve practical and abstract problems across a range of areas in analysis and functional analysis.

**ULO6:** interpret mathematical information communicated in wide range of forms.

## General Assessment Information

### Late Assessment Submission Penalty

From 1 July 2022, Students enrolled in Session based units with written assessments will have the following late penalty applied. Please see <https://students.mq.edu.au/study/assessment-exams/assessments> for more information.

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark) will be applied each day a written assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. Submission time for all written assessments is set at 11:55 pm. A 1-hour grace period is provided to students who experience a technical concern.

For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, students need to submit an application for Special Consideration.

### Assessments where Late Submissions will be accepted

In this unit, late submissions will be accepted as follows:

Assignment 1, Assignment 2 – YES, Standard Late Penalty applies Test 1, Test 2, Final Exam  
- NO, unless Special Consideration is granted

## Assessment Tasks

Name	Weighting	Hurdle	Due
<a href="#">Test 2</a>	10%	No	Week 10
<a href="#">Test 1</a>	10%	No	Week 4
<a href="#">Assignment 1</a>	15%	No	Week 06
<a href="#">Final Exam</a>	50%	No	Examination Period
<a href="#">Assignment 2</a>	15%	No	Week 12

### Test 2

Assessment Type <sup>1</sup>: Quiz/Test

Indicative Time on Task <sup>2</sup>: 5 hours

Due: **Week 10**

Weighting: **10%**

This will be a test held during the semester. It will test the ability of students to analyse and solve mathematical problems using concepts and techniques in real and functional analysis.

On successful completion you will be able to:

- demonstrate a well- developed knowledge of the principles, concepts and techniques of a broad range of areas in analysis and applied mathematics, with significant depth in analysis and functional analysis.
- demonstrate an understanding of the breadth of mathematics, the multi-disciplinary role of mathematics and the way it contributes the development in other related fields of study.
- construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.
- formulate and model practical and abstract problems in mathematical terms using a variety of methods drawn from analysis and functional analysis.
- apply mathematical principles, concepts, techniques and technology efficiently to solve practical and abstract problems across a range of areas in analysis and functional analysis.
- interpret mathematical information communicated in wide range of forms.

## Test 1

Assessment Type <sup>1</sup>: Quiz/Test

Indicative Time on Task <sup>2</sup>: 5 hours

Due: **Week 4**

Weighting: **10%**

This will be a test held during the semester. It will test the ability of students to analyse and solve mathematical problems using concepts and techniques in real and functional analysis.

On successful completion you will be able to:

- demonstrate a well- developed knowledge of the principles, concepts and techniques of a broad range of areas in analysis and applied mathematics, with significant depth in

analysis and functional analysis.

- demonstrate an understanding of the breadth of mathematics, the multi-disciplinary role of mathematics and the way it contributes the development in other related fields of study.
- construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.
- formulate and model practical and abstract problems in mathematical terms using a variety of methods drawn from analysis and functional analysis.
- apply mathematical principles, concepts, techniques and technology efficiently to solve practical and abstract problems across a range of areas in analysis and functional analysis.
- interpret mathematical information communicated in wide range of forms.

## Assignment 1

Assessment Type <sup>1</sup>: Problem set

Indicative Time on Task <sup>2</sup>: 10 hours

Due: **Week 06**

Weighting: **15%**

The assignment will include a set of questions with short answers involving proofs and calculations.

On successful completion you will be able to:

- demonstrate a well- developed knowledge of the principles, concepts and techniques of a broad range of areas in analysis and applied mathematics, with significant depth in analysis and functional analysis.
- demonstrate an understanding of the breadth of mathematics, the multi-disciplinary role of mathematics and the way it contributes the development in other related fields of study.
- construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.
- formulate and model practical and abstract problems in mathematical terms using a variety of methods drawn from analysis and functional analysis.
- apply mathematical principles, concepts, techniques and technology efficiently to solve practical and abstract problems across a range of areas in analysis and functional

analysis.

- interpret mathematical information communicated in wide range of forms.

## Final Exam

Assessment Type <sup>1</sup>: Examination

Indicative Time on Task <sup>2</sup>: 15 hours

Due: **Examination Period**

Weighting: **50%**

The final exam will cover all topics of the unit

On successful completion you will be able to:

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- construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.
- formulate and model practical and abstract problems in mathematical terms using a variety of methods drawn from analysis and functional analysis.
- apply mathematical principles, concepts, techniques and technology efficiently to solve practical and abstract problems across a range of areas in analysis and functional analysis.
- interpret mathematical information communicated in wide range of forms.

## Assignment 2

Assessment Type <sup>1</sup>: Problem set

Indicative Time on Task <sup>2</sup>: 10 hours

Due: **Week 12**

Weighting: **15%**

The assignment will include a set of questions with short answers involving proofs and calculations.

On successful completion you will be able to:

- demonstrate a well- developed knowledge of the principles, concepts and techniques of a broad range of areas in analysis and applied mathematics, with significant depth in analysis and functional analysis.
- demonstrate an understanding of the breadth of mathematics, the multi-disciplinary role of mathematics and the way it contributes the development in other related fields of study.
- construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.
- formulate and model practical and abstract problems in mathematical terms using a variety of methods drawn from analysis and functional analysis.
- apply mathematical principles, concepts, techniques and technology efficiently to solve practical and abstract problems across a range of areas in analysis and functional analysis.
- interpret mathematical information communicated in wide range of forms.

<sup>1</sup> If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the [Writing Centre](#) for academic skills support.

<sup>2</sup> Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

## Delivery and Resources

There is one 2-hour lecture and one 1-hour sgta per week.

## Unit Schedule

WEEK	TOPIC	ASSESSMENT
<b>Real Analysis</b>		
01	The real number system	
02	Sequences	
03	Topology of Real Numbers	
04	Continuity	Test 1: Real Analysis

WEEK	TOPIC	ASSESSMENT
05	Sequences of Functions	
06	Uniform Limits	Assignment 1: Real Analysis
<b>Functional Analysis</b>		
07	Metric spaces	
08	Normed vector spaces, Banach spaces	
09	Lebesgue integral	
10	Inner product spaces, Hilbert spaces	Test 2: Functional Analysis
11	Linear functionals	
12	Dual space.	Assignment 2: Functional Analysis
13	Review	

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central \(https://policies.mq.edu.au\)](https://policies.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- [Academic Appeals Policy](#)
- [Academic Integrity Policy](#)
- [Academic Progression Policy](#)
- [Assessment Policy](#)
- [Fitness to Practice Procedure](#)
- [Assessment Procedure](#)
- [Complaints Resolution Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#)

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

To find other policies relating to Teaching and Learning, visit [Policy Central \(https://policies.mq.edu.au\)](https://policies.mq.edu.au) and use the [search tool](#).

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: <https://students.mq.edu.au/admin/other-resources/student-conduct>

## Results

Results published on platform other than [eStudent](#), (eg. iLearn, Coursera etc.) or released



directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in [eStudent](#). For more information visit [ask.mq.edu.au](http://ask.mq.edu.au) or if you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@mq.edu.au)

## Academic Integrity

At Macquarie, we believe [academic integrity](#) – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free [online writing and maths support](#), [academic skills development](#) and [wellbeing consultations](#).

## Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

### The Writing Centre

[The Writing Centre](#) provides resources to develop your English language proficiency, academic writing, and communication skills.

- [Workshops](#)
- [Chat with a WriteWISE peer writing leader](#)
- [Access StudyWISE](#)
- [Upload an assignment to Studiosity](#)
- [Complete the Academic Integrity Module](#)

The Library provides online and face to face support to help you find and use relevant information resources.

- [Subject and Research Guides](#)
- [Ask a Librarian](#)

## Student Services and Support

Macquarie University offers a range of [Student Support Services](#) including:

- [IT Support](#)
- [Accessibility and disability support](#) with study
- Mental health [support](#)
- [Safety support](#) to respond to bullying, harassment, sexual harassment and sexual assault
- [Social support including information about finances, tenancy and legal issues](#)

## Student Enquiries

Got a question? Ask us via [AskMQ](#), or contact [Service Connect](#).

## IT Help

For help with University computer systems and technology, visit [http://www.mq.edu.au/about\\_us/offices\\_and\\_units/information\\_technology/help/](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.