MATH339

Real and Functional Analysis

S2 Day 2017

Dept of Mathematics

Contents

Disclaimer

General Information

Unit convenor and teaching staff
Lecturer - Unit convenor
Xuan Duong
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Contact via e-mail
12 Wally's Walk, Room 729
Thursday 2 - 3 pm or by appointment

Credit points
3

Prerequisites
(MATH235 and MATH236) 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:

> 1. 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.
>
> 2. 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.
>
> 3. construct sustained logical, clearly presented and justified mathematical arguments
> incorporating deductive reasoning.

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

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

6. appropriately interpret mathematical information communicated in wide range of forms.

7. present mathematical ideas, information, reasoning and conclusions in forms tailored to the needs of diverse audiences.

8. demonstrate an understanding of ethical issues relating to professional mathematical work, identify and address ethical issues arising in such professional work and make ethical decisions while collecting and analysing data and reporting findings.

9. work effectively, responsibly and safely in individual and team contexts.

10. preparing students for further studies in the areas of advanced analysis and applied mathematics.

General Assessment Information

The final examination is worth 50% of your final mark, and is two hours in duration. Calculators with neither text retrieval nor graphing capabilities are allowed to be used during the examination.

Satisfactory performance on supervised assessment tasks, such as tests and the final exam, is necessary to pass this unit at the level of Credit or above.

Please contact the lecturer in case of difficulty over the participation requirements. Past experience clearly indicates that students who do not make a sincere effort in the coursework component of the unit rarely perform well in the final examination.

HURDLES: This unit has no hurdle requirements. This means that there are no second chance examinations and assessments if you happen to fail at your first attempt. Students should aim to get at least 60% for the course work in order to be reasonably confident of passing the unit.

IMPORTANT: If you apply for Disruption to Study for your final examination, you <u>must</u> make yourself available for the week of 11-15 Dec 2017. If you are not available at that time, there is no guarantee an additional examination time will be offered. Specific examination dates and times will be determined at a later date.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	10%	No	Thursday 31 Aug
Assignment 2	10%	No	Thursday 14 Sep
Test	20%	No	Thursday 12 Oct
Assignment 3	10%	No	Thursday 19 Oct
Final exam	50%	No	To be announced

Assignment 1

Due: **Thursday 31 Aug**
Weighting: **10%**

Solve 5 problems

On successful completion you will be able to:
- 1. 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.
- 2. 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.
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- 8. demonstrate an understanding of ethical issues relating to professional mathematical

work, identify and address ethical issues arising in such professional work and make ethical decisions while collecting and analysing data and reporting findings.

- 9. work effectively, responsibly and safely in individual and team contexts.
- 10. preparing students for further studies in the areas of advanced analysis and applied mathematics.

Assignment 2

Due: **Thursday 14 Sep**
Weighting: **10%**

Solve 5 problems

On successful completion you will be able to:

- 1. 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.
- 2. 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.
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Test

Due: **Thursday 12 Oct**
Weighting: **20%**

45 Minute Class test

On successful completion you will be able to:
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Assignment 3

Due: **Thursday 19 Oct**
Weighting: **10%**

Solve 5 problems

On successful completion you will be able to:
- 1. 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.
- 2. 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.
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Final exam

Due: **To be announced**
Weighting: **50%**

2 hour Final Exam

On successful completion you will be able to:
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Delivery and Resources

Lecture time: Tue 9 am - 11 am (23 Wally's Walk W5A 202) and Thu 3 pm - 5 pm (23 Wally's Walk W5A 201);

Tutorial time is included in the lecture time above.

Lecture notes will be available on the web; student can also use

Chen: Fundamentals of Analysis

Chen: Linear Functional Analysis

The following texts are suggested for reference only, and it is not essential to own copies:

Lay: Analysis with an introduction to proof

Gordon: Real Analysis, A First course

Burkill: A First Course in Mathematical Analysis

Burkill and Burkill: A Second Course in Mathematical Analysis

Young: An Introduction to Hilbert Space

Unit Schedule

- Week 1: The number system, completeness and consequences.
- Week 1: Countability, cardinal numbers, Cantor-Bernstein-Schröder theorem.
- Week 2: Sequences and limits, subsequences, general principle of convergence.
- Week 3 and 4: Series, real series, complex series, power series.
- Week 4: Functions and continuity.
- Week 5 and 6: Derivatives and Integrations
- Week 7: Further limits - Uniform Convergence
- Week 8: Metric spaces, open and closed sets, limits and continuity.
- Week 9: Connectedness, completeness, compactness, continuous functions with compact domains.
- Week 10: Normed vector spaces, Banach spaces.
- Week 11: Inner product spaces, Hilbert spaces.
- Week 11: Orthogonal expansions, orthonormal systems, orthonormal bases.
- Week 12: Isomorphism of Hilbert spaces, splitting up a Hilbert spaces
- Week 12: Linear functionals, dual space.
- Week 13: Revision

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_2016.html

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

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy (in effect until Dec 4th, 2017): http://www.mq.edu.au/policy/docs/disruption_studies/policy.html

Special Consideration Policy (in effect from Dec 4th, 2017): https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration

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://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://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

- 1. 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.
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Assessment tasks

- Assignment 1
- Assignment 2
- Test
- Assignment 3
- Final exam

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.

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Learning outcomes

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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:

Learning outcomes

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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

- 1. 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.
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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

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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.

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Learning outcomes

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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

- 1. 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.

- 2. 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.

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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

- 1. 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.
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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

- 1. 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.
- 2. 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.
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