UNSW Course Outline

MATH3051 Applied Real and Functional Analysis - 2024

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General Course Information

Course Code : MATH3051
Year : 2024
Term : Term 3
Teaching Period : T3
Is a multi-term course? : No
Faculty : Faculty of Science
Academic Unit : School of Mathematics & Statistics
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course provides students in Applied Mathematics with basic knowledge of Real Analysis and Functional Analysis, topics that are particularly useful for the study of many other Applied Mathematics courses. In any area of applied research, methods should not be learnt without

understanding their theoretical backgrounds. Understanding the theory behind the methods requires some abstract mathematics, and this forms the contents of this course.

Course Aims

The aim of this course is to provide students in Applied Mathematics with basic knowledge of Real Analysis and Functional Analysis, particularly topics that are useful for the study of many other Applied Mathematics courses.

Relationship to Other Courses

In T3 2024, this course is co-taught with MATH5215 (Special Topics in Applied Mathematics C).

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Distinguish different types of spaces: metric spaces, normed spaces, Banach spaces, and Hilbert spaces.
CLO2 : Compare weak and strong convergence and apply them to the study of numerical approximations.
CLO3 : Apply functional analysis tools to solving integral equations and boundary value problems.
CLO4 : Apply the concept of Gateaux derivative and the Lagrange multiplier method to solving optimisation problems.
CLO5 : Perform the analysis of the Galerkin approximation for linear and non-linear PDEs.

Course Learning Outcomes	Assessment Item
CLO1 : Distinguish different types of spaces: metric spaces, normed spaces, Banach spaces, and Hilbert spaces.	• Test 1 • Test 2 • Assignment • Examination
CLO2 : Compare weak and strong convergence and apply them to the study of numerical approximations.	• Test 1 • Test 2 • Assignment • Examination
CLO3 : Apply functional analysis tools to solving integral equations and boundary value problems.	• Test 2 • Examination
CLO4 : Apply the concept of Gateaux derivative and the Lagrange multiplier method to solving optimisation problems.	• Examination
CLO5 : Perform the analysis of the Galerkin approximation for linear and non-linear PDEs.	• Assignment • Examination

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Test 1 Assessment Format: Individual	15%	Start Date: 01/10/2024 09:00 AM
Test 2 Assessment Format: Individual	20%	Start Date: 29/10/2024 09:00 AM
Assignment Assessment Format: Individual	15%	Start Date: 16/10/2024 11:59 PM Due Date: 10/11/2024 11:59 PM Post Date: 16/10/2024 11:30 PM
Examination Assessment Format: Individual	50%	Start Date: During Exam Period. Date TBA

Assessment Details

Test 1

Assessment Overview

The first written test (40 minutes) will take place in Week 4 in person. You will solve small exercises related to the theory that you will have learnt in Weeks 1-3. You will get feedback in the form of marks and comments from academic staff within two weeks . Solutions will be uploaded to the course webpage where you may also find comments on common serious mistakes.

Course Learning Outcomes

- CLO1 : Distinguish different types of spaces: metric spaces, normed spaces, Banach spaces, and Hilbert spaces.
- CLO2 : Compare weak and strong convergence and apply them to the study of numerical approximations.

Detailed Assessment Description

Date: 9am Tuesday 1 October 2024

Place: Colombo Theatre B

Assessment Length

40 minutes (in-person) class test.

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Test 2

Assessment Overview

The second written test (50 minutes) will be in Week 8 in person. You will be asked to solve small exercises related to the theory that you will have learnt in Weeks 4-7. You will get feedback in the form of marks and comments from academic staff within two weeks. Solutions will be uploaded to the course webpage where you may also find comments on common serious mistakes.

Course Learning Outcomes

- CLO1 : Distinguish different types of spaces: metric spaces, normed spaces, Banach spaces, and Hilbert spaces.
- CLO2 : Compare weak and strong convergence and apply them to the study of numerical approximations.
- CLO3 : Apply functional analysis tools to solving integral equations and boundary value problems.

Assessment Length

50 minutes in person class test.

Assessment information

Date: 9am Tuesday 29 October 2024

Place: Colombo Theatre B

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see here.

Assignment

Assessment Overview

You will complete an assignment focused on using theoretical principles to solve practical problems. The task is due in Week 9. You will get feedback in the form of marks and comments from academic staff within two weeks. Solutions will be uploaded to the course webpage where you may also find comments on common serious mistakes.

Course Learning Outcomes

- CLO1 : Distinguish different types of spaces: metric spaces, normed spaces, Banach spaces, and Hilbert spaces.
- CLO2 : Compare weak and strong convergence and apply them to the study of numerical approximations.
- CLO5 : Perform the analysis of the Galerkin approximation for linear and non-linear PDEs.

Submission notes

Typed by LaTeX. Submit both the LaTeX source file and the pdf file.

Generative AI Permission Level

No Assistance

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Examination

Assessment Overview

The final exam is designed to summarise your learning and problem-solving skills on all topics delivered across the term, including material from lectures, tutorials and workshops. The exam is typically two hours and consists of questions of various sorts which require short answer responses or proofs. The exam will occur during the official university examination period. Feedback is available through inquiry with the course convenor.

Course Learning Outcomes

- CLO1 : Distinguish different types of spaces: metric spaces, normed spaces, Banach spaces, and Hilbert spaces.
- CLO2 : Compare weak and strong convergence and apply them to the study of numerical

approximations.
- CLO3 : Apply functional analysis tools to solving integral equations and boundary value problems.
- CLO4 : Apply the concept of Gateaux derivative and the Lagrange multiplier method to solving optimisation problems.
- CLO5 : Perform the analysis of the Galerkin approximation for linear and non-linear PDEs.

Assessment Length

Two-hour exam (in person) during exam period.

Generative AI Permission Level

No Assistance

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General Assessment Information

The marking schemes of the tests and assignments will be released, together with the solutions, about two weeks after the due date. Statistics of students' results will also be provided.

Grading Basis

Standard

Requirements to pass course

A total of at least 50% is required to pass the course.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 0 : 2 September - 8 September	Reading	You should spend time to refresh your memory of first-year and second-year mathematics by reading Section 1 (Revison on Set Theory) and Section 2 (Revision on Functions) of Chapter 1 in the booklet.
Week 1 : 9 September - 15 September	Lecture	• Sets and Functions • Metric Spaces
	Tutorial	Tutorial sheet 1
Week 2 : 16 September - 22 September	Lecture	• Metric Spaces • Topological Spaces
	Tutorial	Tutorial sheet 2
Week 3 : 23 September - 29 September	Lecture	• Topological Spaces
	Tutorial	Tutorial sheet 3
Week 4 : 30 September - 6 October	Lecture	• Topological Spaces • Measure Theory and Lebesgue Integrals
	Tutorial	Tutorial sheet 4
	Assessment	Written Test 1 • Time and date: 9am Tuesday 1st October 2024 • Place: Colombo Theatre B • Topics: Metric spaces, Topological spaces
Week 5 : 7 October - 13 October	Lecture	• Normed Vector Spaces
	Tutorial	Tutorial sheet 5
Week 6 : 14 October - 20 October	Other	Recharge week
Week 7 : 21 October - 27 October	Lecture	• Normed Vector Spaces • Lp Spaces
	Tutorial	Tutorial sheet 6
Week 8 : 28 October - 3 November	Lecture	• Lp Spaces • Hilbert spaces
	Tutorial	Tutorial sheet 7
	Assessment	Written Test 2 • Time and date: 9am Tuesday 29th October 2024 • Place: Colombo Theatre B • Topics: Lebesgue integrals, Normed vector spaces, Lp spaces
Week 9 : 4 November - 10 November	Lecture	• Hilbert Spaces • Sobolev Spaces
	Tutorial	Tutorial sheet 8
	Assessment	Assignment is due by the end of this week.
Week 10 : 11 November - 17 November	Lecture	• The Galerkin Method • Applications
	Tutorial	Tutorial sheet 9

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

- There are 4 lectures and 1 tutorial per week (Week 1-5, 7-10).
- Lecture slides are uploaded onto Moodle before the lectures each week.
- Tutorial sheets are uploaded onto Moodle before the tutorial each week. Solutions are provided after each tutorial.
- The booklet "Applied Real and Functional Analysis" by Thanh Tran is a main reference. It will

be posted on Moodle.

Course Resources

Prescribed Resources

- Slides: Provided on Moodle.
- Booklet: Applied Real and Functional Analysis by Thanh Tran provided on Moodle.

Recommended Resources

- H. Brezis, Functional Analysis, Sobolev Spaces and Partial Differential Equations, Springer, 2011.
- P.G. Ciarlet, Linear and Nonlinear Functional Analysis with Applications, SIAM, 2013.

Course Evaluation and Development

Responses to last year students' feedback:

- Material is shortened and more advanced topics are referred to the course notes.
- Tutorial sheets contain more practice questions.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Thanh Tran		Anita B Lawrence Centre (H13), previously Red Centre, Room 4061	9385 7041	TBA on Moodle	No	Yes

Other Useful Information

Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University’s conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University’s reputation and good standing.

For more information, visit the UNSW Student Code of Conduct Website.

Academic Honesty and Plagarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.
Further information about referencing styles can be located at https://student.unsw.edu.au/referencing

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage. At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.
Further information about academic integrity, plagiarism and the use of AI in assessments can be located at:

- The Current Students site,
- The ELISE training site, and
- The Use of AI for assessments site.

The Student Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct

Submission of Assessment Tasks

Penalty for Late Submissions

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessments where a penalty applies,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.

Students are expected to manage their time to meet deadlines and to request extensions as

early as possible before the deadline.

Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: https://student.unsw.edu.au/special-consideration

Important note: UNSW has a "fit to sit/submit" rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for Special Consideration. This is to ensure that if you feel unwell or are faced with significant circumstances beyond your control that affect your ability to study, you do not sit an examination or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

Faculty-specific Information

Additional support for students

- The Current Students Gateway
- Student Support
- Academic Skills and Support
- Student Wellbeing, Health and Safety
- Equitable Learning Services
- UNSW IT Service Centre
- Science EDI Student Initiatives, Offerings and Guidelines

School Contact Information

Please visit the School of Mathematics and Statistics website for a range of information.

For information on Courses, please go to "Student life & resources" and either Undergraduate and/or Postgraduate and respective "Undergraduate courses" and "Postgraduate courses" for information on all course offerings.

All school policies, forms and help for students can be located by going to the "Student Services" within “Student life & resources” page. We also post notices in "Student noticeboard" for your information. Please familiarise yourself with the information found in these locations. If you cannot find the answer to your queries on the web you are welcome to contact the Student Services Office directly.

Undergraduate

E: ug.mathsstats@unsw.edu.au

P: 9385 7011 or 9385 7053

Postgraduate

E: pg.mathsstats@unsw.edu.au

P: 9385 7053

Should we need to contact you, we will use your official UNSW email address of in the first instance. **It is your responsibility to regularly check your university email account. Please use your UNSW student email and state your student number in all emails to us.**