

MATH 4063 Functional Analysis
Course Outline- Fall 2023-2024

1. Instructor(s)

Name: Tianling JIN

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2. Teaching Assistant(s)

Name: Zhen Zheng

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3. Meeting Time and Venue

Lectures:

Date/Time: Tuesday and Thursday 13:30-14:50

Venue: Room 6573

Tutorials:

Date/Time: Wednesday (18:00-18:50)

Venue: Room 1027, LSK Bldg

4. Course Description

Credit Points: 3

Pre-requisite: (MATH 3043 OR MATH 4061) AND (MATH 2131 OR grade A- or above in MATH 2121)

Exclusion: NIL

Brief Information/synopsis:

This course covers several fundamental mathematical concepts in Functional Analysis, such as Hahn-Banach theorem, open mapping theorem, closed graph theorem, uniform boundedness theorem, separation theorem, Krein-Milman theorem, weak topologies, adjoints, duality, compact and Fredholm operators, spectral theorem for compact normal operators. It is a proof-based course. Students will learn rigorous mathematical definitions and theorems, and will learn how to write rigorous mathematical proofs.

Intended Learning Outcomes

Upon successful completion of this course, students should be able to:

No.	ILOs
1	Recognize and use appropriately rigorous mathematical definitions.
2	Write rigorous mathematical proofs.
3	Generalize practical problems to abstract mathematical settings.
4	Solve real and hypothetical problems by identifying the underlying mathematics and analyzing the problem.

5. Assessment Scheme

- Examination duration: 3 hrs
- Percentage of coursework, examination, etc.:

<u>Assessment</u>	<u>Assessing Course ILOs</u>
25% by coursework	1, 2, 3, 4
25% by mid-term exam	1, 2, 3, 4
50% by final exam	1, 2, 3, 4

- The grading is assigned based on students' performance in assessment tasks/activities.

6. Student Learning Resources

Recommended Reading:

1. *Functional Analysis, Sobolev Spaces and Partial Differential Equations*

by Haim Brezis, which can be access on campus at

<https://link.springer.com/book/10.1007/978-0-387-70914-7>

2. *Functional Analysis*

By Jan van Neerven, which can be access at: <https://arxiv.org/abs/2112.11166>

7. Teaching and Learning Activities

Scheduled activities: 4 hrs (lecture + tutorial)

8. Course Schedule

Keyword Syllabus:

- The Hahn-Banach Theorem
- The uniform boundedness principle, the open mapping theorem, and the closed graph theorem
- Weak topologies, reflexive spaces, separable spaces, uniform convexity
- L^p spaces
- Hilbert space
- Compact operators and spectral decomposition of self-adjoint compact operator
- Sobolev spaces and their applications to partial differential equations.