

Module code

SPM-3402

Type of module

Undergraduate: Mathematical Sciences – Elective

Functional Analysis



Modular credits

4

Total student
engagement

56 hours

Prerequisite

**SPM-2209 (Real
Analysis)**

Anti-requisite

None

Aims

To develop students' ability to analyse and apply core concepts of functional analysis by integrating algebraic and topological structures through rigorous proof-based reasoning.

Module learning outcomes (MLO)

On successful completion of this module, a student will be expected to be able to:

MLO 1

Analyse fundamental concepts of metric spaces, normed spaces, and Banach spaces.

MLO 2

Evaluate open and closed sets, and analyse convergence and completeness in metric and normed spaces.

MLO 3

Analyse linear operators, boundedness, and continuity, and explain the structure of linear functionals and dual spaces.

MLO 4

Investigate inner product spaces and Hilbert spaces, including concepts of orthogonality, best approximation, direct sums, orthonormal sets, and orthogonal complements.

MLO 5

Synthesise key ideas from real and complex analysis to tackle advanced problems involving dual spaces and orthonormal sequences.

Module contents

Metrics and metric spaces.
Subspaces. Open and closed sets
in metric spaces

Convergence of sequences.
Cauchy sequences and
completeness. Normed spaces.
Banach spaces

Spaces of sequences. Function
spaces with supremum norm.
Finite dimensional spaces

Linear operators. Boundedness and continuity. Spaces of linear operators. Linear functionals. The dual space. Hahn-Banach theorem with examples and applications

Inner product spaces. Hilbert spaces. Orthogonality in Hilbert spaces. Best approximation

Orthogonal complements. Direct sum. Orthonormal sets and sequences. The dual of a Hilbert space

Assessment

60%

Examination

40%

Coursework

Examination
60%

Class tests
30%

■ Examination — 60% ■ Class tests — 30% ■ Assignment — 5% ■ Tutorial Participation — 5%

Formative assessment

Weekly discussion
and feedback

Summative assessment

COMPONENT

WEIGHTING

Examination

60%

Coursework

40%

Individual

40%

Class tests

30%

Assignment

5%

Tutorial Participation

5%

Graduate attributes and skills

Programme learning objectives (PLO) addressed

1

PLO 1 (Core Mathematical Knowledge)

2

PLO 2 (Analytical Problem-Solving)

4

PLO 4 (Mathematical Communication)

6

PLO 6 (Adaptability and Lifelong Learning)

Sustainability concept addressed

4

SDG 4 Quality Education

Digital skills/software used (not limited to)

- Learning management and collaboration platforms (e.g. Canvas)
- Mathematical and computational software (e.g. MATLAB, Mathematica)

Micro-credentialling option

No

Stackable towards GenBESTARI Undergraduate Degree Programme or other relevant Lifelong Learning Programmes

No

Document details

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