MA4532: APPLIED FUNCTIONAL ANALYSIS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Applied Functional Analysis

Subject Code
MA - Mathematics
Course Number
4532

Academic Unit
Mathematics (MA)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA2503 Linear Algebra / MA1503 Linear Algebra with Applications; and
MA2508 Multi-variable Calculus

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course introduces basic notions of functional analysis with important applications. One such notion is the projection theorem of Hilbert spaces, which is the origin of classic approximation theory. Another one is the Fredholm alternative, which produces an elegant theory of linear algebraic systems and
two-point boundary value problems. It also helps students apply functional analysis methods to solve diverse mathematical problems.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	explain clearly properties of normed linear spaces and bounded linear operators on such spaces.	15	x		
2	state and prove various structure theorems on Hilbert and Banach spaces.	15		x	
3	understand applications of Hilbert space structures (including the projection theorem) to approximation by functions and trigonometric series.	25	x	x	
4	state the Fredholm alternative and apply it to algebraic equations, integral equations, operator equations in Hilbert spaces and/or two-point boundary value problems.	25		x	x
5	the combination of CILOs 1-4	20	x	x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Learning through teaching is primarily based on lectures.	1, 2, 3, 4, 5	39 hours in total

2	Take-home assignments	Learning through take-home assignments helps students understand basic theory of Hilbert spaces, the projection theorem, the Fredholm alternative and recognize their diverse mathematical applications.	1, 2, 3, 4	after-class

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Test	1, 2, 3	20	Questions are designed for the first part of the course to see how well the students have learned basic properties of Hilbert spaces and recognized the applications of the projection theorem in function-theoretic approximation.
2	Hand-in assignments	1, 2, 3, 4	20	These are skills based assessment to help students understand structural properties of Hilbert spaces, the Fredholm alternative and the associated results with applications.
3	Formative take-home assignments	1, 2, 3, 4	0	The assignments provide students chances to demonstrate their achievements in applying techniques of functional analysis learned from this course.

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Additional Information for ATs

40% Coursework
60% Examination (Duration: 2 hours, at the end of the semester)
For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

Assessment Rubrics (AR)

Assessment Task
1. Test

Criterion
Ability in problem solving

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
2. Hand-in assignments

Criterion
Understanding of concepts and applications

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
3. Formative take-home assignments

Criterion
Study attitude

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
4. Examination

Criterion
Comprehensive ability in independent problem solving

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Part III Other Information

Keyword Syllabus
Theory of Banach and Hilbert spaces and their applications. Representation of linear functional and orthogonal projections. Dual spaces and their properties.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Nil