Syllabi of Semester-VII and VIII based on UGCF - 2022

DEPARTMENT OF MATHEMATICS

Category-I

B.Sc. (Hons.) Mathematics, Semester-VII

DISCIPLINE SPECIFIC CORE COURSE – 19: LINEAR ANALYSIS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Linear Analysis	4	3	1	0	Class XII pass with Mathematics	Metric Spaces, Advanced Linear Algebra

Learning Objectives: The objective of the course is to introduce:

- Norm and normed spaces, Banach spaces and Hilbert spaces as complete normed spaces and their properties.
- Various forms of matrix norms with examples.
- Classes of bounded linear operators on normed spaces and Hilbert spaces, respectively.
- Four important theorems: Hahn-Banach, Uniform boundedness, Open mapping, and Closed graph as the cornerstones of the theory of Banach spaces.

Learning Outcomes: This course will enable the students to:

- Analyze and demonstrate examples of normed linear spaces with their properties.
- Characterize the bounded linear operators on normed spaces as continuous functions.
- Understand and apply Schwarz and Bessel's inequality, Parseval's identity.
- Illustrate linear operators, self-adjoint, unitary and normal operators on Hilbert spaces.
- Prove and apply fundamental theorems from the theory of normed and Banach spaces.

SYLLABUS OF DSC-19

UNIT – I: Normed Spaces and Banach Spaces (15 hours)

Normed spaces, Banach spaces, Properties of normed spaces, Finite dimensional normed spaces and subspaces, Compactness and finite dimension; Matrix norms; Linear operators, Bounded linear operators; Linear functionals, Linear operators and functionals on finite dimensional spaces; Normed spaces of operators, Dual space.

UNIT – II: Hilbert Spaces **(15 hours)**

Overview of inner product spaces and its properties, Hilbert spaces, Orthogonal complements and direct sums, Orthonormal sets and sequences, Bessel inequality; Total orthonormal sets and sequences; Riesz representations theorem, Hilbert-adjoint operator, Self-adjoint, Unitary and normal operators.

UNIT – III: Fundamental Theorems for Normed and Banach Spaces **(15 hours)**

Hahn Banach theorems for real and complex vector spaces, Hahn Banach theorem for normed spaces; Reflexive spaces**;** Uniform boundedness theorem, Open mapping theorem, Closed graph theorem.

Essential Readings

1. Kreyszig, Erwin (1989). Introductory Functional Analysis with Applications (1st ed.). John Wiley & Sons. Wiley-India Student Edition. Indian Reprint 2007.
2. Horn, Roger A. and Johnson, Charles R. (2013). Matrix Analysis (2nd ed.). Cambridge University Press.

Suggestive Readings

- Bollobás Béla (1999). Linear Analysis: An Introductory Course (2nd ed.). Cambridge University Press.
- Rynne, Bryan P. and Youngson, Martin A. (2008). Linear Functional Analysis (2nd ed.). Springer-Verlag London Limited.