Course No	Course Name	L-T-P-Credits
MA 503	**Functional Analysis**	**3-1-0: 4**

Prerequisite: nil

Course Objectives: Functional analysis is the study of infinite-dimensional vector spaces equipped with some extra structure. The aim of the course is to introduce the ideas and some of the fundamental theorems of functional analysis and to get familiar with its applications in other areas of pure and applied mathematics.

Course Outcomes: After successful completion of the course, students will be able to:

1. Understand how functional analysis uses and unifies ideas from vector spaces, the theory of metrics, and complex analysis.
2. Understand and apply fundamental theorems from the theory of normed and Banach spaces, including the Hahn-Banach theorem, the open mapping theorem, the closed graph theorem, and the Uniform boundedness principle.
3. Understand and apply ideas from the theory of Hilbert spaces to other areas, for example, Fourier series.
4. Understand the fundamentals of spectral theory.

SYLLABUS

Module	Contents	Hours
I	Normed linear spaces, Riesz lemma, Banach spaces; Bounded linear maps on normed linear spaces; Hahn-Banach theorems, uniform boundedness principle, Convergence of sequence of operators, closed graph theorem, open mapping theorem; Dual spaces; Weak and weak* convergence.	18
II	Inner product spaces, orthonormal set, Gram-Schmidt orthonormalization, Bessel's inequality, orthonormal basis, separable Hilbert spaces. Orthonormal complements, orthogonal projections, projection theorem, Riesz representation theorem-dual of a Hilbert space, adjoint of operators, self-adjoint, normal and unitary operators.	14
III	Spectrum of bounded linear operators.	04

Essential Readings:

1. E. Kreyszig, "*Introductory Functional Analysis with Applications*", Wiley, 2007.
2. B. V. Limaye, "*Functional Analysis*", New Age International Private Limited, 2014.

Supplementary Readings:

1. G. F. Simmons, "*Introduction to Topology and Modern Analysis*", McGraw Hill Education, 1st edition, 2017.
2. J. B. Conway, "*A Course in Functional Analysis*", 2nd edition, Springer, 2010.
3. H. Brezis, "*Functional Analysis, Sobolev Spaces and Partial Differential Equations*", Springer, 2011.