MATH-446 Functional Analysis

Credit Hours: 3-0

Prerequisites: None

Course Objectives: This course extends methods of linear algebra and analysis to spaces of functions, in which the interaction between algebra and analysis allows powerful methods to be developed. The course will be mathematically sophisticated and will use ideas both from linear algebra and analysis.

Core contents: Metric Spaces, Normed Spaces and Banach Spaces, Inner Product Spaces and Hilbert Spaces.

Detailed Course Contents: Metric Spaces: Metric spaces, Examples of metric spaces, Open sets, Closed sets, Convergence, Cauchy sequce in metric space, Neighborhood, Completeness of metric spaces.

Normed Spaces and Banach Spaces: Vector Space, Normed Space, Banach Space, Properties of Normed Spaces, Finite Dimensional normed spaces and subspaces, Compactness and finite dimension. Linear Operators, Bounded and Continuous linear operators, Linear Functionals, Linear Operators and Functionals on finite dimensional spaces. Normed spaces of Operators, Dual Spaces.

Inner Product Spaces and Hilbert Spaces: Inner product space, Hilbert space, Properties of inner product spaces, Orthogonal complements and direct sums, Orthonormal sets and sequences.

Text Book: Erwin Kreyszig “Introductory Functional Analysis with Applications” 1989. John Wiley and Sons.

Reference Books:

1. John B. ConwayA Course in Functional Analysis, Springer, 1990.
2. Brezis, Haim Functional Analysis, Sobolev Spaces and Partial Differential E quations,Springer 2010.

Weekly Breakdown		
Week	***Section***	***Topics***
1	1.1-1.2	Metric spaces, Examples of metric spaces,
2	1.3-1.4	Open sets, Closed sets, Neighborhood,
3	2.1-2.3	Convergence, Cauchy sequence in metric space.
4	2.4-2.5	Completeness of metric spaces.
5	2.6	Completion of Metric Spaces
6	2.7	Vector Space, Normed Space, Banach Space, Properties of Normed

		Spaces.
7	2.8	Finite Dimensional normed spaces and subspaces, Compactness and finite dimension
8	2.9	Linear Operators,
9	**Mid Semester Exam**	
10	2.10	Bounded and Continuous linear operators
11	3.1-3.2	Finite Dimensional normed spaces and subspaces, Compactness and finite dimension
12	3.3	Linear Functional
13	3.4	Linear Operators and Functional on finite dimensional spaces
14	3.6	Normed spaces of Operators, Dual Spaces
15	3.10	Inner product space, Hilbert space, Properties of inner product spaces
16	4.2	Orthogonal complements and direct sums
17		Review
18	**End Semester Exam**	