Course Specifications

General Information

Course name	Functional Analysis
Course number	MATH4324
Faculty	
Department	
Course type	Major Needs
Course level	4
Credit hours (theoretical)	3
Credit hours (practical)	0
Course Prerequisites	

Course Objectives

1 - Encourage a view of function analysis as a way of thinking and as a language for communicating ideas to develop effective ways of visualizing abstracting and thinking more generally

2 - Apply mathematical methods for other areas of knowledge

3 - Develop critical, analytical and personal skills that prepare students to be active contributor to the other branches of science as well as to intellectual life of society

4 - Learn the tools and ethics of scientific research in the field of functional analysis

Intended Learning Outcomes

Knowledge and Understanding	* A1- Describe the importance of functional analysis and the relation between functional analysis and other courses in mathematics * A2- Mention the different terminology that is relevant to functional analysis and its applications * A3- Interpret the mathematical theorems in functional analysis and using it in other fields or using it as a base for solution techniques
Intellectual Skills	* B1- Conclude the essential facts, concepts, principles and theories relating to functional analysis and their relationship to other fields
Professional Skills	* C1- Some deep analytical theorem in agroup discussion with students
General Skill	* D1- Practing on solution of specific problems during the course

Course Contents

1 - Metric Topology: - Metric space – Examples of metric spaces – Open and closed sets – Convergence - Completeness and examples of complete metric spaces

2 - Normed Spaces: Definition of normed and Banach spaces – Finite dimensional normed spaces and subspaces – Compactness in finite dimensional normed spaces

3 - Inner Product and Hilbert Spaces: -Definition and examples of inner product spaces – Definitions and examples of Hilbert spaces – Orthogonal complement and orthogonal direct sum decomposition – Orthogonal sets and sequences – Complete (total) orthonormal sets

4 - Linear Functional: Definition and examples of bounded linear functionals – Riesz representation of bounded linear functional on Hilbert space – Dual space and examples of dual spaces

5 - Linear Operators on Normed space : Definition and examples of bounded linear operators, -The Hilbert space adjoint – Self adjoint, Unitary, and normal operators

Teaching and Learning Methods

1 - Lectures using whiteboard or occasionally using data show

2 - Problem discussion sessions with students

3 - Presentation by student teams of some independent work relevant to the course

4 - Independent search of students about certain results or applications

Students Assessment

Assessment Method	TIME	MARKS
Assignments, quizzes, and presentations to assess	during the course	20%
Midterm Examination	Midterm	30%
Final examination	End of the term	50%

Books and References

Essential books	Erwin Kreyszig , Introductory Functional Analysis with Applications, John Wiley and Sons, 1989
Recommended books	I.J Maddox, Elements of Functional Analysis, Second Edition, CUP, 1989

Knowledge and Skills Matrix

Main Course Contents	Study Week	Knowledge and Understanding	Intellectual Skills	Professional Skills	General Skill
Metric Topology: - Metric space – Examples of metric spaces – Open and closed sets – Convergence - Completeness and examples of complete metric spaces	3	A1-A2-A3	B1	C1	D1
Normed Spaces: Definition of normed and Banach spaces – Finite dimensional normed spaces and subspaces – Compactness in finite dimensional normed spaces	3	A1-A2-A3	B1	C1	D1
Inner Product and Hilbert Spaces: -Definition and examples of inner product spaces – Definitions and examples of Hilbert spaces – Orthogonal complement and orthogonal direct sum decomposition	3	A1-A2-A3	B1	C1	D1
Linear Functional: Definition and examples of bounded linear functionals – Riesz representation of bounded linear functional on Hilbert space – Dual space and examples of dual spaces	3	A1-A2-A3	B1	C1	D1
Linear Operators on Normed space : Definition and examples of bounded linear operators, -The Hilbert space adjoint – Self adjoint, Unitary, and normal operators	2	A1-A2-A3	B1	C1	D1