



Course Syllabus  
Gyanmanjari Science College  
Semester-3 (M.Sc.)

**Subject:** Functional Analysis (MSCMA13516)

**Type of course:** Major

**Prerequisite:** Basic knowledge of linear algebra and Banach space theory.

**Rationale:** Functional analysis, a branch of mathematics, extends linear algebra concepts to infinite-dimensional spaces. It studies Hilbert spaces, operators, and spectral theory, with applications in physics, engineering, and optimization.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks					Total Marks
CI	T	P		Theory Marks		Practical Marks		CA	
				ESE	MSE	V	P	ALA	
4	0	0	4	60	30	10	-	50	150

*Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.*

**Course Content:**

Unit No.	Course content	Hrs	% Weight age
1	<b>CHAPTER 1:</b> Inner product spaces, orthonormal sets, Hilbert spaces, orthogonal complements, complete orthonormal sets in a Hilbert space.	15	25
2	<b>CHAPTER 2:</b> Approximation and optimization. Orthogonal Projections and projection theorem, Continuous linear functional on an inner product space and Riesz representation theorems.	15	25
3	<b>CHAPTER 3:</b> Bounded operators and adjoints. Normal, unitary and self-adjoint operators.	15	25
4	<b>CHAPTER 4:</b> Spectrum and Numerical Range, Spectrum of a bounded operator, Compact Self – Adjoint operators, Numerical range of a bounded operator, Hilbert-Schmidt Operators.	15	25



**Continuous Assessment:**

Sr. No.	Active Learning Activities	Marks
1.	<b>Model making :</b> Students are to select a topic from syllabus that they find particularly interesting or challenging. Photo/Video must be uploaded on to the GMIU web portal.	10
2.	<b>Chart :</b> Chart upon application of any topic of syllabus must be prepared by the students and upload to the GMIU web portal.	10
3.	<b>Mathematical Logic Problem:</b> Various problems based on Inner product spaces and Hilbert spaces will be assigned to the students. Students need to submit Mathematical logic and Solution via the GMIU web portal.	10
4.	<b>Analysis :</b> Students will prepare a project on real-world scenarios and students will analyze and prepare a report in 100 words and upload it to the GMIU web portal.	10
5.	<b>PPT Presentation:</b> Students will prepare a PPT presentation on any topic in the syllabus and upload it to the GMIU web portal.	10
<b>Total</b>		<b>50</b>

**Course Outcome:**

After learning the course the students should be able to:	
CO1	Construct orthonormal set and establish the method to obtain the classical system of polynomials.
CO2	Discuss the properties of Hilbert space.
CO3	Explain the properties of self-adjoint, normal and unitary operators
CO4	Find spectrum and numerical range of given operator

