Gyanmanjari Innovative University

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

Subject: Advanced Linear Algebra (MSCMA13514)

Type of course: Major

Prerequisite: Foundational knowledge of matrices, vector spaces, linear transformations and algebra.

Rationale: Advanced Linear Algebra delves into vector spaces, linear transformations, determinants, and canonical forms.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
CI	T	P	C	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	% Weightage
1	**CHAPTER 1:** Quick review of vector spaces, Subspaces, Linear combination, Linear spans, Linear dependence, Linear independence and basis, Dual space, dual basis, second dual, Annihilator, dimension of the annihilator, Applications to system of Linear equations.	15	25
2	**CHAPTER 2:** The Algebra of liner transformations, Minimal polynomial of a linear transformation, Regular and Singular linear transformations, Rank of a linear transformation, Characteristic roots, Matrix associated with a linear transformation, Isomorphism between the space of linear transformations and the space of matrices, Similarity of matrices, Examples and similarity of linear transformations.	15	25
3	**CHAPTER 3:** Canonical Forms: Triangular forms, Triangular matrix associated to a linear transformation, Nilpotent transformations, Existence and uniqueness	15	25

	of invariants of a nilpotent transformation. Jordan Decomposition Form, Examples.		
4	**CHAPTER 4:** Trace, Transpose and their properties, Jacobson's lemma, Definition and properties of determinant, **Quadratic forms**: diagonalization of a symmetric matrix, symmetric matrix associated to a quadratic form, classification of quadratics.	15	25

Continuous Assessment:

Sr. No.	Active Learning Activities	Marks
1.	**Model making :** Engage students in creating physical models or visual representations to illustrate concepts from Gamma and Beta functions, Elliptic Integrals, Error Functions, Laplace Transforms, and Fourier Transforms. Photo/Video must be uploaded on to the GMIU web portal.	10
2.	**Chart:** Chart upon application of any topic of syllabus must be prepared by the students and upload to the GMIU web portal.	10
3.	**Solving Mathematical Logic Problem:** 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.	**Quiz:** Students will prepare a Quiz on each Chapter and upload it to the GMIU web portal.	10
5.	**Prepare a Power Point Presentation:** Faculty will assign topic that Students prepare a power point presentation and upload it to the GMIU web portal.	10
Total		**50**

Course Outcome:

After learning the course the students should be able to:	
CO1	Understand and apply vector spaces, subspaces, linear combinations, dependence, independence, and dual spaces.
CO2	Analyze the properties exhibited by linear transformation and their relationships with matrices.
CO3	Evaluate different types of Canonical forms of linear transformation and understand the matrix theory associated with Vector spaces.
CO4	Apply the concepts of trace, transpose, determinants, and quadratic forms in problem-solving and analyze different quadratic forms and their effects.

Suggested Specification table with Marks (Theory): 60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	10%	40%	30%	10%	10%	-

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MCQ etc.
From the content 10% topics are suggested for flipped mode instruction.
Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

Reference Books:

1. Herstein I. N., Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. Kwak J. H., Hong S., Linear Algebra, (Second Edition), Birkhauser, 2004.
3. Simmons G. F., Introduction to Topology and Modern Analysis, McGraw-Hill Co., Tokyo, 1963.
4. Helson H., Linear Algebra, (Second Edition), Hindustan Book Agency, TRIM-4, 1994.
5. Ramachandra Rao A. and Bhimasankaram P., Linear Algebra (Second Edition), Hindustan Book Agency, TRIM-19, 2000.