

Course Code: 0542-113(Stat-113) **Course Title: Linear Algebra**
Marks:100 **Credits: 03** **Number of Class: 39-42**

Rationale:

The course is designed as an essential part of the curriculum of majors such as: Computer science, Engineering, Economics, Physics, and Mathematics. It is blending computational and conceptual aspects of mathematics.

Objectives:

This course aims to:

- Make Understand the key ideas in linear algebra.
- Upgrade and develop the analytical thinking skills and their ability to communicate technical arguments clearly.
- Clarify the material on vector spaces and related topics.
- Motivate to the geometry of problems in two and three dimensions.
- Give understanding about algorithms of linear algebra, which also central to the theory of scientific computing and numerical analysis.
- Introduce more advanced work in this area including applications to geometry, data fitting and differential equations.

Course Learning Outcomes:

At the end of this course students will be able to

CLO1	Gather knowledge about Angle and orthogonality in inner product spaces and Decompose using Gram-Schmidt Process.
CLO2	Study diagonalization problem with some applications
CLO3	Compute inverse matrices and determinants using row reduction.
CLO4	Acquainted about vector space as a unifying concept for understanding properties of vectors, Polynomials, and matrices.
CLO5	Compute eigen values and eigen vectors.
CLO6	Solve problems from a variety of areas inside and outside Mathematics using system of linear equations.

Mapping between PLOs and CLOs of Statistics program:

PLOs CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3		2	2	1	2	2	

CLO2	2		1	2	1			
CLO3	3		2	1	1			
CLO4	2	1		1	1	1	2	
CLO5	2		2	2	1	2		
CLO6	2		1	2	1			

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lec.
CLO1	Introduction to System of Linear Equations, Gaussian Elimination, Matrix and Matrix operations, Inverse: Algebraic properties of Matrices, Elementary matrices and a method for finding A^{-1} , more on Linear systems and invertible Matrices, Diagonal, Triangular and Symmetric Matrices. Rank of a matrix.	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance and Final Examination.	10
CLO2	Determinant: Meaning and Properties of Determinant, Determinant by Cofactor Expansion, Minors, Cofactors, Ad joint, Combinatorial Approach to Determinant, Evaluating Determinant by Row Reduction, Properties of Determinants: Cramer's Rule. Sarrus diagram for determinants.			4
CLO3	Vector in 2-space, 3-space and n-space, Norm, Dot Product and Distance in R^n , Orthogonality, the Geometry of Linear System, Cross Product. Real Vector spaces, Subspaces, Linear independence and dependence, Coordinates and basis, Dimension, Change of Basis, Row space, Column space, Null space. Rank Nullity and Matrix spaces, Matrix transformation from R^n to R^m . Cauchy -Schwartz inequality and Minkowski's inequality.			8
CLO4	Eigenvalues and Eigenvectors:			5

	Definition of Eigenvalues and Eigenvectors, Diagonalization, Orthogonal Diagonalization. Caley Hamilton theorem, Minimal polynomial of a matrix.			
CLO5	Inner Products, Angle and Orthogonality in Inner Product Spaces, Gram-Schmidt Process QR-Decomposition, Best Approximation: Least Square, Normal, orthogonal and unitary operators, spectral theorem.			7
CLO6	Characteristic Value Problem and Quadratic Form: Characteristic Value Problem, Similarity, Characteristic Roots and Vectors of Matrix, Theorems of Characteristic Roots and Vectors, Orthogonal Matrices, Orthogonal Diagonalization, Quadratic Forms, Index & signature of quadratic form, Jordan canonical form, Hermitian, Unitary and Normal Matrices.			8

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Classroom discussion	Interactive Question-Answer
CLO2	Math games	Assignment and Presentation
CLO3	Classroom Discussion and Problem-solving activities	Practice by doing exercise, Summative (Midterm)
CLO4	Discussion and Slide Show	Practice by doing exercise, Summative (Midterm)
CLO5	Problem-solving activities	Summative Measure (Final Exam.)
CLO6	Lecture and Reflective Discussion	Summative Measure (Final Exam.)

Text Book

1. Anton, H. and Rorres, C. (2014): *Elementary Linear Algebra*, 9th edition, John Wiley and Sons, New York.

Reference Books

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1. Aitken, A.C. (1982): *Determinant and Matrices*, Oliver and Boyd, London.
2. Hadley, G. (1993): *Linear Algebra*, 6th rep., Naroda, New Delhi.
3. Narayan, S. (1985): *A Textbook of Matrices*, 8th edition, Sultan Chand and Co., New Delhi.