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Course Code: MAT134
Semester: II

LINEAR ALGEBRA

Course Objectives:

This course will help the learner to study the fundamental concepts of linear algebra culminating in abstract vector spaces and linear transformations. The course starts with systems of linear equations and some basic concepts of the theory of vector spaces in the concrete setting of real linear n-space. The course then goes on to introduce abstract vector spaces over arbitrary fields and linear transformations, matrices, matrix algebra, similarity of matrices, eigenvalues and eigenvectors. The subject material is of vital importance in image processing and machine learning.

UNIT - I **15 Periods**

Introduction to Matrices and Determinants: Solution of Linear Equations - Cramer's rule - Inverse of a Matrix.

Vectors and linear combinations: Rank of a matrix - Gaussian elimination - LU Decomposition - Solving Systems of Linear Equations using the tools of Matrices

UNIT - II **15 Periods**

Vector space: Dimension - Basis - Orthogonality - Projections - Gram-Schmidt orthogonalization and QR decomposition

UNIT - III **15 Periods**

Eigenvalues and Eigenvectors: Positive definite matrices - Linear transformations - Hermitian and unitary matrices

UNIT - IV **15 Periods**

Singular value decomposition and Principal component analysis - Introduction to their applications in Image Processing and Machine Learning

REFERENCES

1. B. S. Grewal. *Higher Engineering Mathematics*, Khanna Publishers, Forty Third Edition, 2014.

2. Peter V. O'Neil. *Advanced Engineering Mathematics*, Seventh Edition, Cengage Learning, 2011.
3. Michael. D. Greenberg. *Advanced Engineering Mathematics*, Pearson Education, Second Edition, 1998.
4. Gilbert Strang, *Introduction to linear algebra*, Wellsely-Cambridge Press, Fifth Edition, 2016.
5. WartikarP.N, WartikarJ.N. Textbook of *Applied Mathematics*, Volume I and II, Vidyarthi Prakashan, 2010.
6. R C Gonzalez and R E Woods. *Digital Image Processing*, Pearson Education, Third Edition, 2007.
7. https://machinelearningmastery.com/introduction-matrices-machine-learning/

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	Know the basic idea of matrices, determinants, Rank of a matrix and System of linear equations
Unit II	Understand the basic concepts of vector space namely basis, dimensions, orthogonality and Gram-Schmidt orthogonalization
Unit III	Learn the different types of matrices and their eigen values and eigen vectors
Unit IV	Study singular value decomposition and their applications in image processing and machine learning

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Analyze different types of matrices and their properties
- Solve problems in orthogonalisation
- Classify the nature of the square matrices through their eigen values
- Apply the decomposition techniques in image processing with the help of machine learning