Subject Code: 01MA0104
Subject Name: Linear Algebra
B. Tech. Year: I, Semester: II

Objective: This subject aims to provide fundamentals of Linear Algebra using matrix operations and applications of Linear Algebra through Python. The topics delivered in this course are essential for the learners of Computer Engineering, Information Technology and Artificial Intelligence.

Credits Earned: 05 Credits

Course Outcome: After completion of this course, learner will be able to

- Understand concepts of Basis and Dimensions of Vector Space
- Identify the conversion of real life problems into system of linear equations and solve them through several matrix methods
- Apply the concepts of Eigen value and Eigen Vectors to Diagonalization and Quadratic form
- Apply Linear Algebra in Image Processing and Cryptography through Python

Pre-requisite of course: Basic Matrix Operations and Determinant.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	Mid Sem (M)	Internal (I)	Viva (V)	Term work (TW)	
3	2	-	5	50	30	20	25	25	150

Contents:

Units	Topics	Hours
1	**Vector Space** Vector space, Subspace, Linear Combination, Linear independence of vectors, Span, Basis and dimension of vector space, Raw Space, Column Space, Null Space with the concept of Rank and Nullity	12
2	**Matrix Algebra and System of Linear Equations** Types of matrices, Row Echelon Form and Row Reduced Echelon Form of a matrix, Rank and Nullity of a matrix, Homogeneous and Non homogeneous system of Linear equations, Methodology of Gauss-elimination and Gauss-Jordan-elimination, Cramer's Rule, Solution of a system through L-U Decomposition, Consistency of a system of Linear equations, Computing inverse of a matrix by Row operations	12
3	**Eigen Values and Eigen Vectors** Eigen values and Eigen vectors of a matrix, Algebraic Multiplicity and Geometric Multiplicity, Similarity of two matrices and Diagonalization, Cayley - Hamilton theorem, Quadratic and Canonical forms	10
4	**Applications of Linear Algebra through Python** Basic Syntax of Python, Representation and operations on different types of Matrices through Python, Basics of Computer graphics and Image processing using matrix algebra, Basics of Cryptography (Coding-Decoding) through inverse of a matrix	08
	Total	**42 Hours**

References:

1. Introduction to Linear Algebra with Application, Jim Defranza, Daniel Gagliardi, Tata McGraw-Hill
2. Elementary Linear Algebra, Applications version, Anton and Rorres, Wiley India Edition.
3. Linear Algebra, Ron Larson, Cengage Learning
4. Linear Algebra and its Applications, David C. Lay, Pearson Education
5. Numerical Python , Robert Johansson, Apress Publications

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
10%	20%	40%	10%	10%	10%

List of Tutorial:

Tutorial :1 Types of Matrices, Row Echelon Form
Tutorial :2 Rank by REF, RREF and Determinant
Tutorial :3 System of Linear equation by Gauss Elimination and Gauss Jordan Method
Tutorial :4 System of Linear equation by Cramer's Method, Inverse of Matrix by Gauss Jordan and Adjoint Method
Tutorial :5 LU – decomposition, Eigen value by its properties
Tutorial :6 Eigen Value, Eigen Vector, AM and GM
Tutorial :7 Cayley-Hamilton Th., Diagonalization and Orthogonally Diagonalization
Tutorial :8 Quadratic form, Index, Signature and Nature, Canonical form
Tutorial :9 Vector Space and Subspace
Tutorial :10 Linear Combination, LD/LI, Span and Basis
Tutorial :11 Row space, Column space and Null space, Rank and Nullity Th.
Tutorial :12 Eigen value and Eigen vector by Python, Inverse of matrix by Python
Tutorial :13 Cryptography and image processing by Python