Program: B. Sc. - Computer Science				Semester: IV	
Course: Linear Algebra with Python				Course Code: USMACS405	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks - 25)	Term End Examinations (TEE) (Marks-75 in Question Paper)
02	02	-	2 + 1 =3	25	75

Learning Objectives:

- To offer the learner the relevant linear algebra concepts through computer science applications.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Students should be able to solve linear equations and do various matrix computations

CO2: Students should be able to derive Echelon form, Row canonical form, and deal with basis and change of basis computations

CO3: Students should be able to calculate eigenvalues and diagonalize using them and do various linear transformations.

Outline of Syllabus: (per session plan)

Module	Description	No of hours
1	Vectors, Linear Equations, Matrices	10
2	Solving Systems of Linear Equations, Vector spaces, Vector basis	10
3	Eigenvalues, Eigenvectors and Diagonalization, Inner Product, Orthogonality	10
	Total	**30**
PRACTICALS		**30**

Module	Linear Algebra with Python	No. of Hours/Credits 30/2
1	**Vectors, Linear Equations, Matrices**	**10**
	Vectors: Introduction, Vector addition and multiplication, Dot-product, Cross Product, The geometry of sets of vectors, Complex numbers Matrices: Matrices as vectors, Dot Product, Matrix Multiplication, Transpose, Inverse, Matrix Transformations, Determinant and its properties Linear Equations: Basics, Linear Systems of Equations, Homogeneous Systems and otherwise.	
2	**Solving Systems of Linear Equations, Vector spaces, Vector basis**	**10**
	Solving Systems of Linear Equations: Solving triangular system of linear equations, Gaussian Elimination, Echelon form, Row Canonical form Vector spaces: Vector Spaces, Subspaces, Linear Combinations, Vector Span and Spanning Set, Linear Dependence and Independence Vector Basis: Basis and its Dimension & Rank, Change of Basis, Null space and finding a basis for the null space, The Rank of a Matrix and Applications.	
3	**Eigenvalues, Eigenvectors and Diagonalization, Inner Product, Orthogonality**	**10**
	Eigenvalues, Eigenvectors and diagonalization: Eigenvalues and Eigenvectors, Existence of eigenvalues, Coordinate representation in terms of eigenvectors, Diagonalization Inner Product & Outer product: The inner product for vectors, Outer product for vectors Orthogonalization: Orthogonality, Projection orthogonal to multiple vectors, Projecting orthogonal to mutually orthogonal vectors	

PRACTICALS	
Sr. No.	**Topic.**
1	Write a program to perform basic operations of complex number

2	Write a program to perform basic operations of vectors
3	Write a program to perform basic matrix operations
4	Write a program to inverse a matrix
5	Write a program to perform Gaussian Elimination
6	Write a program to convert any matrix to its echelon form
7	Write a program to convert any matrix to its row-canonical form
8	Write a program to enter a given matrix and an eigen value of the same. Find its eigen vector
9	Write a program to perform diagonalization of a matrix given its eigen values and eigen vector.
10	Write a program to do the following: 1. Enter a vector b and find the projection of b orthogonal to a given vector u. 2. Find the projection of b orthogonal to a set of given vectors

RECOMMENDED READING:

Text Books:

1. B. Kolman , D. Hill, Introductory Linear Algebra, An Applied First Course, Pearson Edn; 8th Edn; (2008)
2. Schaum's outlines Linear Algebra, Seymour Lipschutz, Marc Lars Lipson, 4th Edition, McGraw Hill

Reference Books

1. Linear Algebra and Probability for Computer Science Applications, Ernest Davis, A K Peters/CRC Press (2012).
2. Coding the Matrix Linear Algebra through Applications to Computer Science Edition 1, PHILIP N. KLEIN, Newtonian Press (2013)
3. Linear Algebra and Its Applications, Gilbert Strang, Cengage Learning, 4th Edition (2007).
4. Linear Algebra and Its Applications, David C Lay, Pearson Education India; 3rd Edition
5. H.Anton, Chris Rorres, Linear Algebra with Applns., Wiley, 7th Edn; (1994)