SEMESTER: II

Course Code:	Course Title: Mathematical Foundations to Artificial Intelligence

Course Learning Objectives:

1. Covers the concept of vector spaces, subspaces, and their properties.
2. Perform matrix operations, sets and its operations
3. Understand Eigen values and Eigen vectors
4. Covers the concept of graphs, representation of graphs, directed graphs, BFS, DFS

Course Outcomes: On successful completion of the course, the students shall be able to

1. Students will be able to define and explain key concepts such as vector spaces, linear independence, and basis.
2. Students will be able to perform and apply matrix operations, including matrix multiplication, inversion, and row reduction.
3. Students will be capable of solving systems of linear equations using various methods (e.g., Gaussian elimination, matrix inverses).
4. Students will be able to compute eigenvalues and eigenvectors and understand their significance in data analysis and algorithms.
5. Students will understand and apply SVD in contexts such as image compression, noise reduction, and machine learning.
6. Students will be able to define and describe key graph theory concepts, including vertices, edges, paths, cycles, and connectivity.
7. Students will understand different types of graphs, such as directed, undirected, weighted, bipartite, and multigraphs.
8. Students will learn and implement various graph representations, including adjacency matrices, adjacency lists, and edge lists.

Unit-I

Introduction toVectors and Solving Linear Equations:

Vectors and Linear Combinations, Lengths and Dot Products, Matrices, Vectors and Linear Equations, The Idea of Elimination, Elimination Using Matrices, Rules for Matrix Operations, Inverse Matrices, Factorization, Transposes and Permutations, Vector Spaces, Orthogonality and Determinants.

Unit-II

Set Theory, Eigenvalues and Eigenvectors:

Introduction to Sets and Set Operations, Introduction to Eigenvalues, Diagonalizing a Matrix, Symmetric Matrice, Singular Value Decomposition (SVD)

Unit-III

Introduction to Graphs:
Graphs and Simple Graphs, Graphs Isomorphism, The Incidence and Adjacency Matrices, Subgraphs, Vertex Degrees, Paths and Connection, Cycles, The Shortest Path Problem, Graph representations, including adjacency matrices, adjacency lists, and edge lists.

Unit-IV

Directed Graphs:
Directed Graphs, Directed Paths, Directed Cycles, Job Sequencing Problem, DFS, BFS.

Text books:

1. Gilbert Strang, Introduction to Linear Algebra, Sixth Edition, WELLESLEY - CAMBRIDGE PRESS, 2023
2. K. H. Rosen, Discrete Mathematics and its Applications, 7th ed., McGraw – Hill, 2012.
3. NarsinghDeo, Graph Theory with Applications to Engineering and Computer Science, PHI, 1979

References:

1. J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Application to Computer Science, Reprint, India: Tata McGraw Hill Education, 2008.
2. Richard J Trudeau, Introduction to Graph Theory, 2nd Edition, Kindly Edition, 1976

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Course Code:	Course Title: Mathematical Foundations to Artificial Intelligence Lab using Python

List of Assignments

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1) Python program to find rank of a matrix
2) Python program to find determinant of a matrix
3) Python program to find trace and Normal of a matrix
4) Python program to find Inverse Matrices
5) Python program to find Eigen values of matrices
6) Python program to demonstrate Orthogonal and Orthonormal Vectors
7) Python program to implement BFS
8) Python program to implement DFS
9) Python program to demonstrate Graphs Isomorphism
10) Python program to demonstrate Singular Value Decomposition
11) Python program to solve Shortest Path Problem using Dijkstra's algorithm
12) Python program to find Adjacency Matrices
13) Python program to find in and out degrees of all vertices in a graph
14) Python Program to Detect a Cycle in a Directed Graph,
15) Python program to solve Job Sequencing Problem