Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune - 5
First Year of B.Sc. (Data Science)
(2025 Course under NEP 2020)

Course Code : 24CsDscU1105
Course Name : Computational Mathematics
Teaching Scheme: TH: 2 Hours/Week **Credit : 02**
Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisites: Vectors, Functions, Polynomials, Matrices, Determinant.

Course Objectives: To study
- Determinants
- System of linear equations
- Linear transformations
- Eigenvalues and Eigenvectors.

Course Outcomes: On completion of the course, student will be able to:-
- Find the determinant of a given matrix
- Find echelon form a matrix
- Solve system of linear equations
- To check whether given transformation is linear or not
- Find a matrix of general linear transformation.
- Verify Rank-Nullity theorem
- Find eigenvalues and eigenvectors of a square matrix.
- Check whether given matrix is diagonalizable or not
- Represent the quadratic form in the form of a matrix and vice versa.
- Apply concepts learnt in this course to solve some real world problems arising out as an application of linear algebra.

Course Contents:

Chapter 1	**Determinants**	**04 hours**
	• Determinants by Cofactor Expansion • Evaluating Determinants by Row Reduction • Properties of the Determinant Function	

Chapter 2	**System of linear equations**	**10 hours**
	• Introduction to System of Linear Equations • Row reduction and echelon form of a matrix • LU Decomposition of a Matrix • Gauss elimination method • Gauss –Jordan elimination method	
chapter 3	**Linear Transformations**	**10 hours**
	• Euclidean n-Space • General Linear Transformations. • Kernel and Range • Rank Nullity Theorem • Matrix of general Linear Transformations.	
Chapter 4	**Eigenvalues and Eigenvectors**	**06 hours**
	• Eigenvalues and Eigenvectors. • Diagonalization.	
	Total No. of Hours	**30**

Reference Books:

1) Elementary Linear Algebra (Applications Version) by Howard Anton, Chriss Rorres, John Wiley and Sons Inc.(Ninth edition), 2010 .
2) Linear Algebra and Its Applications by David Lay, Steven Lay and Judi McDonald, Pearson, Fifth edition.
3) Introduction to Linear Algebra, S. Lang, Springer-Verlag (Second edition), 1986.
4) Linear Algebra by K. Hoffmann and R. Kunze, Prentice Hall of India (Second edition), 1998.

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune - 5
First Year of B.Sc. (Data Science)
(2025 Course under NEP 2020)

Course Code : 24CsDscU1106
Course Name : Lab Course on Computational Mathematics
Teaching Scheme: PR: 4 Hours/Week **Credit : 02**
Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisites: Vectors, Functions, Polynomials, Matrices, Determinant.

Prerequisites: Vectors, Functions, Polynomials, Matrices, Determinant.

Course Objectives: To study
- Determinants
- System of linear equations
- Linear transformations
- Eigenvalues and Eigenvectors.

Course Outcomes: On completion of the course, student will be able to:-
- Find the determinant of a given matrix
- Find echelon form a matrix
- Solve system of linear equations
- To check whether given transformation is linear or not
- Find a matrix of general linear transformation.
- Verify Rank-Nullity theorem
- Find eigenvalues and eigenvectors of a square matrix.
- Check whether given matrix is diagonalizable or not
- Represent the quadratic form in the form of a matrix and vice versa.
- Apply concepts learnt in this course to solve some real world problems arising out as an application of linear algebra.

Course Contents:

	List of Practicals	60 Hours
Practical 1	Determinants	
Practical 2	Matrices using Scilab	
Practical 3	Echelon form and LU decomposition of a Matrix	
Practical 4	System of linear equation	

Practical 5	System of linear equations using Scilab	
Practical 6	Polynomials using Scilab	
Practical 7	Graphs of functions using Scilab/Geogebra	
Practical 8	Eigenvalues and Eigenvectors	
Practical 9	Eigenvalues and Eigenvectors using Scilab	
Practical 10	Linear transformation	
Practical 11	Rank-Nullity Theorem	
Practical 12	Applications of Linear Algebra	
Practical 13	Two dimensional transformations using Python	
Practical 14	Three dimensional transformations using Python	
Practical 15	Projections using Python	

Note: For every batch there will be 4 hours for each practical session per week.

Reference Books:

1) Elementary Linear Algebra (Applications Version) by Howard Anton, Chriss Rorres, John Wiley and Sons Inc.(Ninth edition), 2010 .
2) Linear Algebra and Its Applications by David Lay, Steven Lay and Judi McDonald, Pearson, Fifth edition.
3) Introduction to Linear Algebra, S. Lang, Springer-Verlag (Second edition), 1986.
4) Linear Algebra by K. Hoffmann and R. Kunze, Prentice Hall of India (Second edition), 1998.

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune - 5
First Year of B.Sc. (Data Science)
(2025 Course under NEP 2020)

Course Code : 24CsDscU2105
Course Name : Graph Theory
Teaching Scheme: TH: 2 Hours/Week **Credit : 02**
Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisite: Set Theory

Course Objectives: To Study

- Graphs, types of graphs.
- Operations on graphs viz. Union, Intersection, Ring Sum and Product.
- Connected graphs and its properties.
- Trees and their properties.

Course Outcomes: On completion of the course, student will be able to:-

- Convert real life problems into graph theoretical models.
- Check whether two graphs are isomorphic or not.
- Apply basic operations on graphs and connected graphs.
- Find the shortest path for a given graph.
- Apply Tree Traversal algorithms for a given tree
- Find the shortest spanning tree for a given graph.

Course Contents:

Chapter 1	**Graphs**	4 Hours
	• Graphs as Models. • Types of graphs. • Isomorphism. • Adjacency and Incidence Matrix of a Graph.	
Chapter 2	**Operations on Graphs**	6 Hours
	• Subgraphs, Induced subgraphs. • Vertex deletion, Edge deletion. • Complement of a graph. • Union and Intersection.	

	● Ring Sum and Product of graphs. ● Fusion of vertices.	
Chapter 3	**Connected Graphs.**	10 Hours
	● Walk, Trail, Path and Cycle. ● Connected Graphs. ● Distance between two vertices, eccentricity, center, radius and diameter of a graph. ● Isthmus and Cutvetex. ● Cutset, edge-connectivity, vertex connectivity. ● Weighted Graphs. ● Dijkstra's Algorithm.	
Chapter 4	**Trees**	10 Hours
	● Trees. ● Center of a tree. ● Binary Tree. ● Tree Traversals. ● Spanning Tree. ● Kruskal's Algorithm.	
	Total No. of Lectures	**30**

Reference Books:

1) A First Look at Graph Theory by John Clark and Derek Holton, Allied Publishers (1st Indian edition), 1995.
2) Graph Theory with Applications to Computer Science and Engineering by Narsingh Deo, Prentice Hall of India (3rd Indian edition), 1986.

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune - 5
First Year of B.Sc. (Data Science)
(2025 Course under NEP 2020)

Course Code: 24CsDscU2106

Course Name: Lab Course on Graph Theory

Teaching Scheme: PR: 4 Hours/Week **Credit: 02**

Examination Scheme: CIA: 20 Marks **End-Semester: 30 Marks**

Prerequisite: Set Theory

Course Objectives: To Study

- Graphs, types of graphs.
- Operations on graphs viz. Union, Intersection, Ring Sum and Product.
- Connected graphs and its properties.
- Trees and their properties.

Course Outcomes: On completion of the course, student will be able to:-

- Convert real life problems into graph theoretical models.
- Check whether two graphs are isomorphic or not.
- Apply basic operations on graphs and connected graphs.
- Find the shortest path for a given graph.
- Apply Tree Traversal algorithms for a given tree
- Find the shortest spanning tree for a given graph.

Course Contents:

	List of Practicals	**60 Hours**
Practical 1	Graphs.	
Practical 2	Matrix of a Graph.	
Practical 3	Operations on Graphs.	
Practical 4	Isomorphism of Graphs.	
Practical 5	Eccentricity, center, radius and diameter of a graph.	
Practical 6	Dijkastra's Algorithm.	

Practical 7	Connectivity.	
Practical 8	Chinese Postman Problem.	
Practical 9	Travelling Salesman Problem.	
Practical 10	Trees	
Practical 11	Fundamental Circuits and cutsets	
Practical 12	Tree Traversal algorithms	
Practical 13	Binary tree	
Practical 14	Kruskal's and Prim's algorithms	
Practical 15	Directed Graphs	

Reference Books:

1) A First Look at Graph Theory by John Clark and Derek Holton, Allied Publishers (1st Indian edition), 1995.
2) Graph Theory with Applications to Computer Science and Engineering by Narsingh Deo, Prentice Hall of India (3rd Indian edition), 1986.