Discipline Specific Core (DSC): 04 Credits

DSC 4 (II.1) Discretizing and Understanding Real Life Situations through Mathematical Lens
Discipline Specific Core

1. Credit Distribution of the Course

Course title & Code DSC 4 (II.1)	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Discretizing and Understanding Real Life Situations through Mathematical Lens	4	3	0	1	Undergraduate	Mathematics in Class XII

2. Learning Objectives

This paper aims to help students understand the basic concepts of linear algebra, enabling them to solve various physical problems, such as balancing chemical equations, analyzing network flow, calculating electric circuit flow, etc. Linear algebra concepts have wide applications in many fields, such as economics, physics, natural sciences, social sciences, data sciences, engineering, etc. Additionally, the course covers the basic concepts of graph theory and their applications in the life sciences and other fields. This paper also explores the relationship between graph theory and linear algebra. The lab activities provide hands-on experiments using suitable software.

3. Learning Outcomes

After completing this course, students should be able to;

- Understand the geometrical concepts of linear algebra
- Apply the concept of linear systems to solve real-life problems
- Understand the concept of transformations and their applications in computer graphics & other fields
- Understand the importance of graphs and their applications
- Understand theoretical and practical knowledge of linear algebra and graph theory
- Understand the relationship between graph theory and linear algebra
- Understand the assignment problem and their importance in real-life
- Learn hands-on experiments using suitable software
- Create projects using fundamental knowledge in order to provide a hands-on experience of the same.

4. Syllabus

Unit I: Vectors and geometry, matrices, multiplication, transpose, determinants, inverses, echelon form, Gaussian elimination, linear dependence and independence, solution and application of system of linear equations. **[12 hours]**

Unit II: Linear transformations and their applications. introduction to sub-spaces and bases, rank, eigenvalues and eigenvectors. **[9 hours]**

Unit III: Graphs (Bipartite, Euler, Hamiltonian, Planar), graphs and adjacency matrices, Euler's V-E+F=2 theorem and its applications, subdivisions, Kuratowski's theorem and application. **[12 hours]**

Unit IV: Matching, Hall's Marriage theorem and application, assignment problems, counting sets, subsets, multisets, inclusion/exclusion, applications. **[12 hours]**

5. Illustrative Practical Details **[30 hours]**

- Representation of vectors in 2D and 3D
- Dealing with matrices and arithmetic operations
- Matrix formulation and solution of linear systems
- Geometric transformations of images: translation, scaling, rotation, etc.
- Analyzing and visualizing graphs
- Graphs and adjacency matrices
- Hand-on projects

6. Essential Readings

- Lay D.C. (2005). *Linear Algebra and its Applications,* Pearson.
- Poole D. (2010). *Linear Algebra: A Modern Introduction,* Brooks Cole.
- Rosen. K.H. (2008). *Discrete Mathematics and Its Applications,* McGraw-Hill.

7. Suggestive Readings

- Axler, S (2025) Linear Algebra Done Right, Open Access.
- Sterling, M.J. (2009) Linear Algebra for Dummies, Wiley.
- Krantz, S.G (2015) How to Teach Mathematics, American Mathematical Society.