Semester	**6**
Course	**Major-1**
Paper Code	
Paper Title	**Algebra-4**
No. of Credits	**4**
Theory / Practical / Composite	**Theory**
Minimum number of preparatory hours per week a student has to devote	**4**
Number of Modules	**Nil**
Syllabus	Solving problems of matrices by the use of linear transformations, the rank-nullity theorem **(2)**. Row space and column space of a matrix. Row rank, column rank, determinant rank and their equality. Rank of product of two matrices **(6)**. Dual spaces, dual basis, double dual **(4)**, transpose of a linear transformation and its matrix in the dual basis, annihilators **(4)**. Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem **(8)**, the minimal polynomial for a linear operator, diagonalizability in connection with minimal polynomial, and canonical forms **(8)**. Inner product spaces and norms- Examples, Cauchy-Schwarz Inequality **(4)**, Orthogonal and orthonormal basis, Gram-Schmidt orthogonalization process **(5)**, orthogonal complements, Bessel's inequality **(3)**. The adjoint of a linear operator. Normal and self-adjoint operators and their diagonalizability **(8)**.
Learning Outcomes	On successful completion of the course, a student will be able to do the following: • Get introduced to solving matrix problems using linear transformations and apply the Rank–Nullity Theorem effectively. • Understand the concepts of row space, column space, row rank, column rank, determinant rank and their equality, along with the rank of the product of two matrices. • Gain knowledge of dual spaces, dual bases, double duals, annihilators, and the transpose of linear transformations with respect to dual bases.

	• Explore eigenspaces, diagonalizability, invariant subspaces, Cayley–Hamilton theorem, minimal polynomial, and study canonical forms of linear operators. • Work with inner product spaces, including norms, Cauchy–Schwarz inequality, orthogonal and orthonormal bases, Gram–Schmidt process, orthogonal complements, and Bessel's inequality. • Understand the adjoint of linear operators, and study the properties and diagonalizability of normal and self-adjoint operators.
Reading/Reference Lists	1. **Linear Algebra**: Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence. 2. **Linear Algebra**: Kenneth Hoffman, Ray Kunze. 3. **Linear Algebra Done Right**: Sheldon Axler. 4. **Introduction to Linear Algebra**: Gilbert Strang. 5. **Linear Algebra--a Geometric Approach**: S. Kumaresan. 6. **Higher Algebra (Linear and Abstract)**: S.K.Mapa.
Evaluation	End Sem; 70 CIA:30(20(MidSem)+5(Assignment) +5(Attendance))
Paper Structure for Theory Semester Exam	7 questions each carrying 10 marks out of 13/14 questions.