Under-Graduate Programme with MATHEMATICS; 1st Semester

MATHEMATICS **MAJOR COURSE**

MMT126J: THEORY OF MATRICES **Credits: 4 THEORY + 2 TUTORIAL**

Theory: 4 Credits (60 Hours) **Tutorial: 2 Credits (30 Hours)**

Course Objectives: (i) To understand matrix theory as a tool to solve various problems of real life situations. (ii) to study the properties and applications of matrices.

Course Outcome: (i) After the completion of this course, students shall be able to use matrix as an operator to solve problems from various disciplines (ii) The matrix analysis can be used in coding theory, linear algebra and cryptography (iii) the stability of various systems can be established by using matrix analysis.

Theory: 4 Credits

Unit –I

Algebraic operations on matrices over R and C with emphasis on non-commutativity. Transpose A^T, inverse A^{-1}, and their basic properties including reversal laws. Conjugate transpose A^* and its algebraic properties. Structural properties of symmetric, skew-symmetric, Hermitian, and skew Hermitian matrices. Decomposition of a square matrix into the form $A = P + iQ$, where P is Hermitian and Q is skew-Hermitian. Basic idea of adjoint of a square matrix and its connection with matrix inversion.

Unit –II

Elementary row operations and their representation via elementary matrices. Row echelon form and reduction of a matrix to normal form PAQ. Invertibility of matrices and its connection with row reduction. Representation of non-singular matrices as products of elementary matrices. Systematic solution of linear homogeneous systems $AX = 0$ and non-homogeneous systems $AX = B$. Conditions for consistency and description of solution sets.

Unit –III

Linear combinations, span, and the concept of basis in R^n and C^n. Linear dependence and independence of vectors. Rank of a matrix via row-reduction and its interpretation as the number of linearly independent rows or columns. Relationship between rank r, number of variables n, and the dimension $n-r$ of the solution space of $AX = 0$. Trace of a matrix and its basic properties, including $\mathrm{Tr}(AB) = \mathrm{Tr}(BA)$.

Unit –IV

Matrix polynomials and algebraic functions of matrices. Characteristic polynomial and minimal polynomial of a matrix. Eigenvalues and eigenvectors as invariants of linear transformations. Cayley–Hamilton theorem and its use in computations. Inner product on R^n and C^n, norms, and orthogonality. Orthonormal sets and geometric interpretation of length and angles.

Tutorial: 2 Credits

Unit –V

Problems based Unit-I and Unit-II

Unit –VI

Problems based Unit-III and Unit-IV

Books Recommended:

1.A Text Book of Matrices, Aziz and Nisar, Kapoor Book Depot., Srinagar, 2015.

2.A textbook of Matrices, Shanti Narayan, S. Chand- 2019

3.Linear Algebra, K. Hoffman and R. Kunze, Pearson Education,2nd edition-2015.

4.Linear Algebra, Schaum's outline series, Tata McGraw-Hill, 6th edition-2018.