

## SEMESTER – VII

### MJC-13: Ring Theory and Linear Algebra-II

#### Course Outcomes

After the completion of the course, the student will be able to:

- CO1: Appreciate the significance of factorization in rings and integral domains.  
CO2: Compute the characteristic polynomial, eigenvalues, eigenvectors, and eigenspaces, as well as the geometric and the algebraic multiplicities of eigenvalues.  
CO3: Compute inner products and determine orthogonality on vector spaces, including Gram-Schmidt orthogonalization to obtain orthonormal basis.

MJC-13: Ring Theory and Linear Algebra-II (5 credits) Full Marks-100		
Unit	Topics to be covered	No. of Lectures
1	Field of quotients of an integral domain, Embedding of rings, Polynomial rings, The Division algorithm and consequences, The Remainder Theorem, The Factor Theorem, Irreducible Polynomials, Reducible polynomials, Primitive Polynomial, Gauss's Lemma, Irreducibility tests, Unique factorization domains.	14
2	Linear Functionals, Dual spaces, dual basis, Double dual, Annihilators, Transpose of a linear transformation and its matrix in the dual basis.	12
3	Eigenspaces of a linear operator, Diagonalization of Linear Operators, Invariant subspaces, The minimal polynomial for a linear operator.	10
4	Inner products and Norms, Orthonormal basis, Gram-Schmidt orthogonalization process, Orthogonal complements, Bessel's inequality.	10
5	The adjoint of a linear operator, Least squares approximation, Minimal solutions to systems of linear equations, Normal and Self-Adjoint Operators, Unitary and orthogonal operators	14
TOTAL		60

#### Book References:

1. Gallian, Joseph. A. (2019). Contemporary Abstract Algebra (9th ed.), Cengage Learning India Private Limited.
2. Friedberg, Stephen H., Insel, Arnold J., & Spence, Lawrence E. (2022). Linear Algebra (5th ed.), Pearson Education.
3. Herstein, I. N. (2006). Topics in Algebra (2nd ed.). Wiley Student Edition. India.
4. Hoffman, Kenneth M., & Kunze, Ray Alden (1978). Linear Algebra (2nd ed.). Prentice-Hall of India Pvt. Limited. Delhi. Pearson Education India Reprint, 2015.
5. Kumaresan, S. (2000). Linear Algebra: A Geometric Approach, Prentice Hall India Learning Private Limited, New title Edition