

Module Code: MATH-308
Module Title: **Rings and Vector Spaces**
Module Rating: 3 Cr. Hours

Ring Theory

- Definition and example of rings
- Special classes of rings
- Fields
- Ideals and quotient rings
- Ring homomorphisms
- Prime and maximal ideals
- Field of quotients

Vector Spaces

- Vector spaces, subspaces
- Linear combinations, linearly independent vectors
- Spanning set
- Bases and dimension of a vector space
- Homomorphism of vector spaces
- Quotient spaces

Linear Mappings

- Mappings, linear mappings
- Rank and nullity
- Linear mappings and system of linear equations
- Algebra of linear operators
- Space $L(X, Y)$ of all linear transformations

Matrices and Linear Operators

- Matrix representation of a linear operator
- Change of basis
- Similar matrices
- Matrix and linear transformations
- Orthogonal matrices and orthogonal transformations
- Orthonormal basis and Gram Schmidt process

Eigen Values and Eigen Vectors


- Polynomials of matrices and linear operators
- Characteristic polynomial
- Diagonalization of matrices

Dual Spaces

- Linear functionals
- Dual space
- Dual basis
- Annihilators

Recommended Books

1. J. Rose, *A Course on Group Theory*, (Cambridge University Press, 1978)
2. I. N. Herstein, *Topics in Algebra*, (Xerox Publishing Company, 1964)


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3. G. Birkhoff and S. MacLane, *A Survey of Modern Algebra*, (Macmillan, New York, 1964)
4. P. B. Battacharya, S. K. Jain and S. R. Nagpaul, *Basic Abstract Algebra*, (Cambridge University Press, 1986)
5. V. Sahai and V. Bist, *Algebra*, 2nd edition, (Narosa Publishing House, 2003)
6. W. Keith Nicholson, *Elementary Linear Algebra*, (PWS-Kent Publishing Company, Boston, 2004)
7. Seymour Lipschutz, *Linear Algebra*, 3rd edition, (McGraw Hill Book Company, 2001)



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