## Syllabus: Linear Algebra-Qualification Exam

## Textbook: Linear Algebra by K. Hoffman and R. Kunze

- Matrices and system of linear equations: Elementary row operations and elementary matrices, The rank of a matrix and matrix inverses, Systems of linear equations, Determinants, Properties of determinants, Transpose of a matrix.
- Vector spaces: Subspaces, Linear combinations and systems of linear equations, Linear dependence and linear independence, Bases and dimension.
- Linear transformations: Linear transformations and operators, Null spaces, Ranges, The matrix representation of a linear transformation, Composition of linear transformations and matrix multiplication, Invertibility and isomorphisms, Change of basis, Linear functionals and dual spaces, Trace of a linear transformation, Determinant of a linear operator on finite dimensional spaces.
- **Eigenspaces**: Eigenvalues, Eigenvectors, Diagonalizability, Characteristic polynomial, Minimal polynomial, The Cayley-Hamilton theorem, Invariant subspaces, Reduction to the triangular forms, Jordan forms, Rational canonical forms.
- Inner products spaces: Orthogonal direct sums, Orthonormal basis, The Gram-Schmidt orthogonalization process.