

COMPLEX VARIABLES AND LINEAR ALGEBRA SYLLABUS

Module 1: Analytic Functions

- Complex Variable
- Analytic Functions and Cauchy-Riemann Equations
- Laplace Equation and Harmonic Functions
- Construction of Harmonic Conjugate and Analytic Functions
- Applications of Analytic Functions to Fluid Flow and Electric Field Problems

Module 2: Conformal and Bilinear Transformations

- Conformal Mapping
 - Elementary Transformations: Translation, Magnification, Rotation, Inversion
 - Exponential and Square Transformations (e.g., e^z , z^2)
 - Bilinear Transformation
 - Cross-Ratio
 - Images of Regions Bounded by Straight Lines Under the Above Transformations

Module 3: Complex Integration

- Functions Given by Power Series
 - Taylor and Laurent Series
- Singularities, Poles, and Residues
- Integration of Complex Functions Along a Contour
- Cauchy-Goursat Theorem (Statement)
- Cauchy's Integral Formula
- Cauchy's Residue Theorem
- Evaluation of Real Integrals Using Indented Contour Integration

Module 4: Vector Spaces

- Vector Spaces and Subspaces
- Linear Combinations and Span
- Linearly Dependent and Independent Sets
- Bases and Dimensions
- Finite Dimensional Vector Spaces
- Row and Column Spaces
- Rank and Nullity

Module 5: Linear Transformations

- Definition and Basic Properties of Linear Transformations
- Invertible Linear Transformations
- Matrices of Linear Transformations
- Vector Space of Linear Transformations
- Change of Bases
- Similarity of Matrices

Module 6: Inner Product Spaces

- Dot Products and Inner Products
- Lengths and Angles of Vectors
- Matrix Representations of Inner Products
- Gram-Schmidt Orthogonalization

Module 7: Matrices and Systems of Equations

- Eigenvalues and Eigenvectors
- Properties of Eigenvalues and Eigenvectors
- Cayley-Hamilton Theorem
- Systems of Linear Equations
- Gaussian Elimination Method
- Gauss-Jordan Method