

Syllabus

MATH 601-602: Methods of Applied Mathematics - I

PART I: Linear Algebra

1. Chapter 1: Matrices and Systems of Equations
 - Systems of Linear Equations
 - Row Echelon Form
 - Matrix Arithmetic
 - Matrix Algebra
 - Elementary Matrices
2. Chapter 2: Determinants
 - The Determinant of a Matrix
 - Properties of Determinants
3. Chapter 3: Vector Spaces
 - Definition
 - Subspaces
 - Linear Independence
 - Basis and Dimension
 - Change of Basis
 - Row Space and Column Space
4. Chapter 4: Linear Transformations
 - Definition and Examples
 - Matrix Representations of Linear Transformations
 - Similarity
5. Chapter 5: Orthogonality
 - The Scalar Product in \mathbb{R}^n
 - Orthogonal Subspaces
 - Least Squares Problems
 - Inner Product Spaces
 - Orthonormal Sets
 - The Gram-Schmidt Orthogonalization Process
6. Chapter 6: Eigenvalues
 - Eigenvalues and Eigenvectors
 - Systems of Linear Differential Equations
 - Diagonalization

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PART II: Complex Variables

1. Chapter 1: Complex Numbers

- Complex numbers
- Complex Plane (\mathbb{C}) Versus Euclidean Plane (\mathbb{R}^2)
- Polar Coordinates
- De Moivre's Theorem
- Roots of a Complex Number

2. Chapter 2: Convergence and Limit

- Convergence and Limit; Cauchy Criterion, Tests for Convergence
- Functions of a Complex Variable: Continuity
- Sequences and Series of Functions; Power Series

3. Chapter 3: Differentiation and Integration

- Differentiation: Cauchy-Riemann Equations
- Integration: Green's Theorem in the Real and Complex Plane, Cauchy's Theorem, Morera's Theorem
- Differentiation and Integration of Power Series
- Cauchy's Integral Formulas and Related Theorems: Cauchy's Theorem in Multiply Connected Domains, Liouville's Theorem
- The Taylor and Laurent Expansions
- Singularities of Analytic Functions

4. Chapter 4: Residue Theory and Evaluation of Integrals and Series

- Residues
- Calculation of Residues
- The Residue Theorem
- Partial Fractions
- Residue at Infinity
- Evaluation of Real Integrals