MA 001 Preparatory Mathematics I.

Complex numbers as ordered pairs. Argand’s diagram. Triangle inequality. De Moivre’s Theorem.

Algebra: Quadratic equations and expressions. Permutations and Combinations.

Binomial theorem for a positive integral index.


Inverse of a matrix. Cramer’s rule.

MA 002 Preparatory Mathematics II.


Tangents and Normals. Increasing and decreasing functions. Maxima and Minima.

Integration as the inverse process of differentiation. Integration by parts and by substitution. Definite integral and its application to the determination of areas (simple cases).
• Vectors in $\mathbb{R}^n$, notion of linear independence and dependence, linear span of a set of vectors, vector subspaces of $\mathbb{R}^n$, basis of a vector subspace.

• Systems of linear equations, matrices and Gauss elimination, row space, null space, and column space, rank of a matrix.

• Determinants and rank of a matrix in terms of determinants.

• Abstract vector spaces, linear transformations, matrix of a linear transformation, change of basis and similarity, rank-nullity theorem.

• Inner product spaces, Gram-Schmidt process, orthonormal bases, projections and least squares approximation.

• Eigenvalues and eigenvectors, characteristic polynomials, eigenvalues of special matrices (orthogonal, unitary, hermitian, symmetric, skew-symmetric, normal), algebraic and geometric multiplicity, diagonalization by similarity transformations, spectral theorem for real symmetric matrices, application to quadratic forms.

**Texts/References:**

MA 108 Differential Equations - I

• Exact equations, integrating factors and Bernoulli equations.
• Orthogonal trajectories.
• Lipschitz condition, Picard’s theorem, examples on nonuniqueness.
• Linear differential equations generalities.
• Linear dependence and Wronskians.
• Dimensionality of space of solutions, Abel-Liouville formula.
• Linear ODE’s with constant coefficients, the characteristic equations.
• Cauchy-Euler equations.
• Method of undetermined coefficients.
• Method of variation of parameters.
• Laplace transform generalities.
• Shifting theorems.
• Convolution theorem.

Texts/References

MA 109 Calculus-I 3 1 0 4

- Review of limits, continuity, differentiation, Mean value theorem, Taylor’s Theorem, Maxima and Minima, Riemann integrals, Fundamental theorem of Calculus, Improper integrals, applications to area, volume.
- Convergence of sequences and series, power series.
- Partial Derivatives, gradient and directional derivatives, chain rule, maxima and minima, Lagrange multipliers.

Texts/References


MA 111 Calculus -II 3 1 0 4

- Double and Triple integration, Jacobians and change of variables formula.
- Parametrization of curves and surfaces, vector Fields, line and surface integrals.
- Divergence and curl, Theorems of Green, Gauss, and Stokes.

Texts/References

MA 205 Complex Analysis  3 1 0 4

- Definition and properties of analytic functions.
- Cauchy-Riemann equations, harmonic functions.
- Power series and their properties.
- Elementary functions.
- Cauchy’s theorem and its applications.
- Taylor series and Laurent expansions.
- Residues and the Cauchy residue formula.
- Evaluation of improper integrals.
- Conformal mappings.
- Inversion of Laplace transforms.

Texts/References

MA 207 Differential Equations-II  3 1 0 4

- Review of power series and series solutions of ODE’s.
- Legendre’s equation and Legendre polynomials.
- Regular and irregular singular points, method of Frobenius.
- Bessel’s equation and Bessel’s functions.
- Strum-Liouville problems.
- Fourier series.
- D’Alembert solution to the Wave equation.
- Classification of linear second order PDE in two variables.
- Laplace, Wave, and Heat equations using separation of variables.
- Vibration of a circular membrane.
- Heat equation in the half space.
Texts/References


MA 214 Introduction to Numerical Analysis 3 1 0 8

- Interpolation by polynomials, divided differences, error of the interpolating polynomial, piecewise linear and cubic spline interpolation.

- Numerical integration, composite rules, error formulae.

- Solution of a system of linear equations, implementation of Gaussian elimination and Gauss-seidel methods, partial pivoting, row echelon form, LU factorization Cholesky’s method, ill-conditioning, norms.

- Solution of a nonlinear equation, bisection and secant methods.

- Newton’s method, rate of convergence, solution of a system of nonlinear equations, numerical solution of ordinary differential equations, Euler and Runge-Kutta methods, multi-step methods, predictor-corrector methods, order of convergence, finite difference methods, numerical solutions of elliptic, parabolic, and hyperbolic partial differential equations.

- Eigenvalue problem, power method, QR method, Gershgorin’s theorem.

- Exposure to software packages like IMSL subroutines, MATLAB.

Texts/References

