

DEPARTMENT OF MATHEMATICS
UNIVERSITY OF ALLAHABAD
(w.e.f. 2025-26)

B.Sc./ B.A. (Semester - 1)

PAPER 1: GEOMETRY - I

STRAIGHT LINES AND PLANES (Using Vector technique)

Normal form of equation, intercept form of equation and general equation of a plane, plane passing through three points, angle between two planes, two sides of a plane, Length of perpendicular from a point to a plane, Bisectors of angles between two planes, Planes passing through the line of intersection of two planes.

Symmetrical and non-symmetrical form of equations of a line, transformation of non-symmetrical form to symmetrical form, Planes passing through a line, coplanar lines, The shortest distance between two lines, Length of perpendicular from a point to a line, Orthogonal projection of a point and a line on a plane, Lines intersecting two lines, intersection of three planes, volume of a tetrahedron, pair of planes.

SPHERES

Equation of a sphere, Plane section of a sphere and intersection of two spheres, spheres passing through a circle, tangent plane, plane of contact, polar lines, angle of intersection of two spheres, power of a point, radical plane, line, centre of spheres, coaxial system of spheres, Orthogonal systems of spheres.

CONES AND CYLINDERS

Cones and cylinders with given base, intersection of a cone and a plane passing through the vertex of the cone, tangent lines and planes, reciprocal cones, normal plane passing through a generator of the cone, right circular cones and cylinders.

Books recommended:

1. Mata Ambar Tiwari and R. S. Sengar: A course in Vector Analysis and its Applications.
2. N. Saran and R. S. Gupta: Analytical Geometry of Three Dimensions.

**DEPARTMENT OF MATHEMATICS
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B.Sc./ B.A. (Semester - 1)

PAPER 2 : ELEMENTARY ANALYSIS - I

Statements, Connectives (Conjunction, Disjunction, Negation, Conditional and Biconditional Joins), Statement formulas, Tautologies, Implication and equivalences, Statement Functions, Quantifiers, Sets, Relations, Equivalence and Order relations, Partitions, Functions, Direct and Inverse images of subsets under maps.

Axiomatic introduction of $\mathbb{R}$ as a complete ordered field, Existence of square roots of positive real numbers.

PROPERTIES OF INTEGERS

Natural numbers, First Principle of induction, Well ordering property of $\mathbb{N}$, Second principle of Induction, Integers and rational numbers, Archimedean Property, Rational and Irrational Density Theorems, Division and Euclidean Algorithm in $\mathbb{Z}$, Primes, Fundamental Theorem of Arithmetic, Irrationality of surds.

SEQUENCES

Intervals in $\mathbb{R}$, Real sequences and their algebra, Limit of a sequence, Bounded, convergent, monotone and Cauchy sequences, Cauchy's general principle of convergence, Algebra of limits (passage to limits under addition, multiplication, inversions and inequality), Divergence of sequences.

Books recommended:

1. Sherbert and Bartle: Introduction to Real Analysis.
2. N. N. Bhattacharya: Elementary Analysis.
3. Thomas and Finney: Calculus and Analytic Geometry.
4. T.M. Apostol: Calculus Vol. 1.
5. Smith and Albrecht: Fundamental Concepts in Analysis.
6. S. C. Malik: Mathematical Analysis.
7. Arora and Bansilal: Real Analysis.

**DEPARTMENT OF MATHEMATICS
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B.Sc./ B.A. (Semester - 1)

PAPER 3 : DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS - I

Origin, concept and formation of an ordinary differential equation and its solution, order and degree of differential equation, First order equations, separable equations, equations reducible to separable form, exact equations. Integrating factors, linear equations, Equations solvable for p , x or y , Clairaut's equations, singular solutions.

Picard's iteration method, initial-value problems and statement of existence and uniqueness Theorems, Geometrical meaning of a differential equation and its solution, Isoclines and direction field, Curves under given geometrical conditions, orthogonal trajectories, mechanical applications (Newton's law of cooling, growth and decay problems, motions in a resisting medium, escape velocity).

Homogeneous linear differential equations, linearly dependent and independent solutions, fundamental system of solutions, equations with constant coefficients.

Books recommended:

1. R. S. Sengar: Ordinary Differential Equations.
2. E. Kreyszig: Advanced Engineering Mathematics.
3. B. Rai and D. P. Choudhury: Ordinary Differential Equations: An Introduction.
4. G. F. Simmons: Differential Equations.

**DEPARTMENT OF MATHEMATICS
UNIVERSITY OF ALLAHABAD**

B.Sc./ B.A. (Semester - 2)

PAPER 1: GEOMETRY - II

POLAR COORDINATES:

Polar equation of a parabola, ellipse and hyperbola when focus is taken as pole, Polar equations of the chord joining two points, tangent, normal, polar (chord of contact), pair of tangents, asymptotes, director circle and auxiliary circle of a conic.

GENERATING LINES

Ruled surfaces, generating lines of a hyperboloid of one sheet and hyperbolic paraboloid and its properties, generators through a point on the principal elliptic section of hyperboloid of one sheet, (θ, ϕ) point on hyperboloid of one sheet and equations of generators at (θ, ϕ) point.

CENTRAL CONICOIDS AND PARABOLOIDS

Standard equations of central conicoids and paraboloids, tangent lines and planes, polar planes and polar lines, enveloping cones and cylinders, section with given centre, diametral planes of central conicoids and paraboloids, Locus of point of intersection of three mutually perpendicular tangent planes to central conicoids and paraboloids, Normal drawn from a point to a central conicoid and a paraboloid, Cone passing through the normals drawn from a point to central conicoid and paraboloid, Conjugate diameters of an ellipsoid and its properties.

Books recommended:

1. R. S. Gupta and R. D. Pathak: Conic Sections.
2. N. Saran and R. S. Gupta: Analytical Geometry of Three Dimensions.

**DEPARTMENT OF MATHEMATICS
UNIVERSITY OF ALLAHABAD**

B.Sc./ B.A. (Semester - 2)

PAPER 2: ELEMENTARY ANALYSIS - II

LIMITS AND CONTINUITY

Real valued functions of one variable, their graphs and algebra, Neighbourhoods of a point and limit points of subsets of $\mathbb{R}$, Limit of a function at limit point of its domain, sequential characterization of limit of a function, Algebra of limits. One-sided limits, Limit of a function as $x \rightarrow \pm \infty$, Infinite limits.

Continuity, Local Boundedness and local maintenance of sign, Boundedness and intermediate value properties of continuous functions over closed intervals, Image of a closed interval under continuous maps.

DIFFERENTIABILITY

Differentiability of a function at a point and its geometrical interpretation, algebra of differentiable functions, Chain rule of differentiation, sign of derivatives and monotonicity of functions, Interior Extremum Theorem, Rolle's Theorem, Lagrange's Mean value Theorem, Cauchy's Mean value Theorem.

APPLICATIONS OF DERIVATIVES

Higher derivatives, Leibnitz Theorem, Taylor's and Maclaurin's Theorem with Lagrange's and Cauchy's forms of remainders, Maxima and minima, Local extremum points (necessary and sufficient conditions), Indeterminate Forms, L'Hospital's rule, Convexity and concavity, Points of inflexion, curvature of curves in explicit form $y = f(x)$, Darboux's Theorem on intermediate value property of derivatives.

Books recommended:

1. Sherbert and Bartle: Introduction to Real Analysis.
2. N. N. Bhattacharya: Elementary Analysis.
3. Thomas and Finney: Calculus and Analytic Geometry.
4. T.M. Apostol: Calculus Vol. 1.
5. Smith and Albrecht: Fundamental Concepts in Analysis.
6. S. C. Malik: Mathematical Analysis.
7. Arora and Bansilal: Real Analysis.

**DEPARTMENT OF MATHEMATICS
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B.Sc./ B.A. (Semester - 2)

PAPER 3: DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS - II

Methods of undetermined coefficients, Variation of parameters and operators for determining particular integrals, Euler-Cauchy equations, Linear systems of differential equations with constant coefficients, Applications to damped and forced oscillations.

Derivatives of a vector function of a single scalar variable, scalar and vector fields, Gradient, divergence and curl, vector identities.

Orthogonal curvilinear coordinates, spherical polar and cylindrical polar coordinates, double integrals, Line, surface and volume integrals, Green's, Stokes' and Gauss' Theorems (statements only) and their simple applications.

Books recommended:

1. R. S. Sengar: Ordinary Differential Equations.
2. E. Kreyszig: Advanced Engineering Mathematics.
3. B. Rai and D. P. Choudhury: Ordinary Differential Equations: An Introduction.
4. Mata Ambar Tiwari and R. S. Sengar: A Course in Vector Analysis and its Applications.
5. G. F. Simmons: Differential Equations.

**DEPARTMENT OF MATHEMATICS
UNIVERSITY OF ALLAHABAD**

B.Sc./ B.A. (Semester - 3)

PAPER 1: LINEAR ALGEBRA-I

Definition of a field, Examples $\mathbb{R}$, $\mathbb{C}$, $\mathbb{Q}$ and $\mathbb{Z}_p$ of fields. Vector Space: definition, examples and basic properties, Subspaces, subspace generated by a subset, Linear dependence and independence of a subset, Basis and Dimension of a vector space, Sum and direct sum of subspaces, Quotient spaces.

Linear transformations and Isomorphism of vector spaces, Null space, range space, rank and nullity of linear transformations, Fundamental theorem of homomorphism, Rank nullity Theorem, $\text{Hom}(V, W)$ as a vector space. $\dim \text{Hom}(V, W) = \dim V \cdot \dim W$. Dual space V^* and transpose of a linear transformation, Annihilator of a subset of a vector space.

Matrix representation of linear transformation. Algebra of matrices, Effect of change of basis on matrix representation. Equivalent and similar matrices, Rank and nullity of a matrix, System of linear equations, their consistency and inconsistency Reduction of a matrix to normal form and algorithms to find the inverse (if it exists), Definition of Determinant and statement of properties (without proof), Co-factor, Adjoint of a matrix and its properties.

Books recommended:

1. K. Hoffman and R. Kunze: Linear Algebra.
2. I. N. Herstein: Topics in Algebra, 2nd Edition.
3. Serge Lang: Introduction to Linear Algebra 2nd Edition.
4. Ramji Lal: Algebra Vol. II.
5. M. Artin: Algebra.

**DEPARTMENT OF MATHEMATICS
UNIVERSITY OF ALLAHABAD**

B.Sc./ B.A. (Semester - 3)

PAPER 2: ANALYSIS-I

Series of Positive Terms: Convergence of Infinite series, addition and removal of terms, term test, Cauchy's criterion, Series of positive terms, Comparison Theorem, Comparison Test, Ratio and Root Tests, Comparison of ratios, Raabe's test, Logarithmic ratio test, Cauchy's Condensation test, De Morgan & Bertrand's test, higher logarithmic ratio test.

General Series: Convergence of arbitrary infinite series, Alternating Series, Absolute and conditional convergence, Abel's and Dirichlet's test, rearrangement of series, Dirichlet's and Riemann's Theorem on rearrangement of absolutely and conditionally convergent series, convolution (Cauchy) product of series, Mertens' Theorem.

Riemann's Theory of Integration: Step functions and their integrals, upper and lower integrals of a bounded function, Integrable functions, Riemann's condition of integrability, Properties of integrals, Mean Value Theorem for Integrals, Differentiations of functions defined by integrals, Fundamental Theorem of integral calculus, primitives, change of variables, Integral Test.

Books recommended:

1. S. C. Malik : Mathematical Analysis.
2. Smith & Albrecht : Fundamental Concepts of Analysis.
3. D. Widder : Advanced Calculus.
4. Arora & Bansi Lal : Real Analysis.
5. Shanti Narayan : Real Analysis.
6. T. M. Apostol : Mathematical Analysis.

**DEPARTMENT OF MATHEMATICS
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B.Sc./ B.A. (Semester - 3)

PAPER 3: MECHANICS-I

Statics: Common centenary, Virtual work and Stability of equilibrium.

Dynamics of a Particle: Rectilinear Motion: Simple Harmonic Motion including the cases of horizontal and vertical elastic strings, Motion under inverse square law, Motion in resisting media, Motion of varying mass.

Books recommended:

1. S. L. Loney: Statics.
2. R. S. Varma: Statics.
3. P. L. Srivastava: Elementary Dynamics.

**DEPARTMENT OF MATHEMATICS
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B.Sc./ B.A. (Semester - 4)

PAPER 1: LINEAR ALGEBRA-II

Inner product space: Definition and Examples, Cauchy Schwarz inequality, Norm of a vector, Notion of angle, Orthogonality, Orthonormal set and basis, Gram Schmidt orthonormalization, Bessel's Inequality, Orthogonal complement, Adjoint of a linear transformation, inner product and distance preserving transformations (orthogonal and Unitary), Hermitian, skew Hermitian, Symmetric and Skew Symmetric matrices. Invariant Subspaces, Eigenvalues, Eigenvector, Characteristic polynomials of a Linear transformation, Cayley - Hamilton Theorem.

Diagonalization of a matrix with distinct Eigenvalues, Orthogonal (Unitary) reduction of real Symmetric (Hermitian) matrices.

Bilinear forms, Equivalence of bilinear forms, matrix representation of Bilinear forms, Quadratic forms, Classification of Symmetric, Skew Symmetric bilinear forms over $\mathbb{R}$ and $\mathbb{C}$. Sylvesters law of inertia, Classification of curves and surfaces represented by equations of 2nd degree.

Books recommended:

1. K. Hoffman and R. Kunze: Linear Algebra.
2. I. N. Herstein: Topics in Algebra, 2nd Edition.
3. Serge Lang: Introduction to Linear Algebra 2nd Edition.
4. Ramji Lal: Algebra Vol. II.
5. M. Artin: Algebra.

**DEPARTMENT OF MATHEMATICS
UNIVERSITY OF ALLAHABAD**

B.Sc./ B.A. (Semester - 4)

PAPER 2: ANALYSIS-II

Convergence of Improper Integrals: Second Mean Value Theorem for Integrals, Integrals over infinite intervals with bounded integrands, Convergence of such integrals, Necessary and sufficient conditions, Case of positive integrands, comparison test, μ - test, absolute convergence, convergence of integrals of product of two functions, Abel's and Dirichlet's test Convergence of integrals with unbounded integrands.

Metric Spaces: Definition and examples of Metric spaces, Open balls, interior, boundary, closure and accumulation points, Open and closed sets, Interior and closure of sets, Limits of sequences in Metric spaces, Cauchy sequences, Completeness.

Books recommended:

1. S. C. Malik: Mathematical Analysis.
2. G. F. Simmons: Topology & Modern Analysis.
3. D. Widder: Advanced Calculus.
4. Arora & Bansilal: Real Analysis.
5. Shanti Narayan: Real Analysis.
6. T. M. Apostol: Mathematical Analysis.

**DEPARTMENT OF MATHEMATICS
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B.Sc./ B.A. (Semester - 4)

PAPER 3: MECHANICS-II

Motion in plane: Kinematics and kinetics of motion, velocity and acceleration in Cartesian, polar and tangential & normal coordinates, determination of path under a given force.

Constrained Motion: Motion in a vertical circle, Cycloidal motion.

Motion under Central Forces: Conservation of angular momentum, areal velocity, differential equation to the path of a particle moving under a central attractive force, (p, r) equation to the path, energy equation, Kepler's laws of planetary motion.

Books recommended:

1. P. L. Srivastava: Elementary Dynamics.
2. R. S. Varma: Statics.

**DEPARTMENT OF MATHEMATICS
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B.Sc./ B.A. (Semester - 5)

PAPER –1: ABSTRACT ALGEBRA-I

Semigroups, Groups: definition, elementary properties and Examples including V_4 , Q_8 , D_8 , Z_m , U_m , Group of symmetries of regular n -gons, Matrix groups and group of Rigid motion of R^n (Example), Homomorphism, Isomorphism, To determine homomorphism between groups given above, Subgroups, Subgroup generated by a subset, Cyclic groups, order of an element. Classification of cyclic groups, Subgroups of above groups, Group of automorphisms, center of a group, coset decomposition, Lagrange Theorem and applications to number Theory (Euler's Theorem, Fermat Theorem and Wilson's Theorem).

Product of groups, Normal subgroups, Quotient groups, correspondence theorem, Fundamental Theorem of homomorphisms, 1st and 2nd Isomorphism Theorem and their applications, commutator subgroups, Abelianizer.

Symmetric Groups, Representation of a finite group as a symmetric group and as an orthogonal group, Cycle and Transposition, decomposition of permutations, Alternating map, Even and odd permutations, Alternating groups, Normal subgroups of S_n .

Books Recommended:

1. I. N. Herstein: Topics in Algebra, 2nd Edition, Wiley Eastern Ltd. 1988.
2. M. Artin: Algebra, Prentice-Hall of India Pvt. Ltd. New Delhi, 1994.
3. J.B. Fraleigh: Narosa Publishing House, New Delhi 1998.
4. Ramji Lal: Algebra Vol. I, Shail Publication.
5. David M. Burton: Elementary Number Theory, Tata McGraw-Hill Publishing Company Ltd., New Delhi 2007.
6. I. Niven, H. S. Zuckerman, H.L. Montgomery: The Theory of Numbers, John Wiley & Sons, India 2000.

**DEPARTMENT OF MATHEMATICS
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B.Sc./ B.A. (Semester - 5)

PAPER 2: ADVANCED ANALYSIS-I

Functions of several variables: Limits of a function between Metric spaces, Continuity, Characterization of continuity in terms of open sets, closed sets and closures, Continuity of linear transformations and inner product function, Examples from functions between Euclidean spaces, Repeated limits.

Compact Metric spaces, Total Boundedness, Sequential compactness, Lebesgue Covering Lemma, Uniform continuity, Preservation of compactness under continuous maps, Completeness of metric spaces.

Partial derivatives, Directional derivatives, differentiability of functions of several variables, Sufficient conditions for continuity and differentiability in terms of partial derivatives, algebra of differentiable functions, Differentiability of composite function, Chain rule of differentiation, Total differentials, Mean value Theorem for real valued functions.

Homogeneous functions and Euler's Theorem, Equality of Mixed derivatives, Young's and Schwarz' Theorems, Higher differentials, Taylor's Theorem, Maxima and Minima for real valued functions of several variables, Necessary and sufficient conditions, Saddle points, Lagrange's Multipliers.

Jacobian Matrix and determinants, Implicit Function Theorem (Proof only $f: \mathbb{R}^2 \rightarrow \mathbb{R}$), Inverse Function Theorem (Statement only), Functional dependence.

Books Recommended:

1. S. C. Malik: Mathematical Analysis.
2. G. F. Simmons: Topology & Modern Analysis.
3. T. M. Apostol: Mathematical Analysis.
4. D. Widder: Advanced Calculus.
5. Arora & Bansilal : Real Analysis.
6. Shanti Narayan : Mathematical Analysis.

**DEPARTMENT OF MATHEMATICS
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B.Sc./ B.A. (Semester - 5)

PAPER 3: ADVANCED MECHANICS-I

Statics (Using Vector Technique): Forces in three dimensions, Line Coordinates of a line, Central Axis and Wrench, Resultant wrench of two wrenches, Null line, Null plane, Null point with respect to a system of forces, conjugate forces and conjugate lines.

Moment of Inertia: Moment and product of inertia of some standard bodies, Principal axes, Momental Ellipsoid of a body.

D'Alembert's principle: The general equation of motion, Motion of the Centre of inertia and motion relative to the centre of inertia.

Motion about a fixed Axis: Moment of the effective forces about the axis of rotation, moment of momentum about the axis of rotation, kinetic energy of the body rotating about a fixed axis, equation axis, equation of motion about axis of rotation, reactions of the axis of rotation.

Books Recommended:

1. Mata Ambar Tiwari and R. S. Sengar: A Course in Vector Analysis and its Applications.
2. S. L. Loney: Dynamics of a Particle and of Rigid Bodies.

**DEPARTMENT OF MATHEMATICS
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B.Sc./ B.A. (Semester - 5)

PAPER 4 : NUMERICAL METHODS-I

Need for numerical methods, floating point representation, rounding off rules. Solution of arbitrary equations: Fixed point iteration method, Bisection method, Method of false position (Regula-Falsi), Newton-Raphson's method.

Interpolation: Operators: Δ , ∇ , μ , δ , E and D and their relationship, forward, backward and central difference-tables, Gregory-Newton Forward and Backward interpolation formulas, Lagrange's and Newton's Divided difference interpolation formulas, inverse interpolation, Formulas based on central differences: Gauss', Stirling's, Bessel's and Everett's interpolation formulas.

Cubic spline interpolation, clamped and natural splines.

Books Recommended:

1. E. Kreyszig: Advanced Engineering Mathematics.
2. K. Sankara Rao: Numerical Methods for Scientist and Engineers.
3. S. S. Sastry: Introductory Methods of Numerical Analysis.
4. Jain, Iyengar and Jain: Numerical Methods for Scientific and Engineering Computation.
5. F. B. Hildebrand: Numerical Analysis.

**DEPARTMENT OF MATHEMATICS
UNIVERSITY OF ALLAHABAD**

B.Sc./ B.A. (Semester - 6)

PAPER –1: ABSTRACT ALGEBRA-II

Group action: Definition and Examples including regular and inner conjugation action, orbit and Isotropy groups. Class formula with special reference to Inner conjugation, Conjugacy classes and centralizer, Normalizer and Conjugacy class of subgroups, Prime power order group and its center being non-trivial, Abelian property of groups of order p^2 , Classification of groups of order p^2 , Classification of groups of order up to 8.

Rings, Subrings, Homomorphisms, Examples of rings including Z_m , $Z[i]$, $Z[w]$, Matrix rings, Quaternion rings, Ideals, quotient rings, Fundamental Theorem of homomorphism, Correspondence Theorem, Integral domains, characteristic of an integral domain, Division rings and Fields, Field of fractions of a commutative integral domain, Polynomial ring over Commutative ring with identity, and over fields, division algorithm, remainder and factor theorem, Ideals of $F[X]$.

Linear Congruences and an algorithm to find solutions of linear congruences, groups of units of Z_m , Chinese remainder Theorem, quadratic residues, Euler's Criterion, Legendre Symbol, Gauss's Quadratic Reciprocity Theorem. Multiplicativity of Euler's phi function, Divisor function, sum of divisor function and Moebius functions, Moebius Inversion Theorem and its some applications.

Books Recommended:

1. I. N. Herstein: Topics in Algebra, 2nd Edition, Wiley Eastern Ltd. 1988.
2. M. Artin: Algebra, Prentice-Hall of India Pvt. Ltd. New Delhi, 1994.
3. J.B. Fraleigh: A First Course in Abstract Algebra, Narosa Publishing House, New Delhi 1998.
4. Ramji Lal: Algebra Vol. I, Shail Publication.
5. David M. Burton: Elementary Number Theory, Tata McGraw-Hill Publishing Company Ltd., New Delhi 2007.
6. I. Niven, H. S. Zuckerman and H.L. Montgomery: The Theory of Numbers, John Wiley and Sons, India 2000.

**DEPARTMENT OF MATHEMATICS
UNIVERSITY OF ALLAHABAD**

B.Sc./ B.A. (Semester - 6)

PAPER 2: ADVANCED ANALYSIS-II

Uniform Convergence: Pointwise and uniform convergence of sequences and series of functions, Necessary & sufficient conditions (Cauchy's criterion), Weierstrass', Abel's and Dirichlet's test for uniform convergence, Term by term integration and differentiation of infinite sequences & series of functions.

Power series, Interval of convergence, uniform convergence of power series, Abel's limit theorem, Taylor and Maclaurin series for functions of one variable, Standard functions (sine, cosine, exponential, logarithmic) defined by power series and their properties.

Complex Analysis: Convergence of Power series over $\mathbb{C}$, Differentiability of function $f: D \rightarrow \mathbb{C}$ ($D \subseteq \mathbb{C}$), Analyticity, Cauchy-Riemann equations, Analyticity of functions defined by power series inside the circle of convergence, Complex standard functions $\exp(z)$, $\sinh(z)$, $\cosh(z)$, $\cos(z)$, $\sin(z)$, $\log(z)$ and their representation in terms of real functions.

Books Recommended:

1. S. C. Malik: Mathematical Analysis.
2. G. F. Simmons: Topology & Modern Analysis.
3. T. M. Apostol: Mathematical Analysis.
4. D. Widder: Advanced Calculus.
5. Arora and Bansilal: Real Analysis.
6. Shanti Narayan: Mathematical Analysis.
7. J.B. Conway: Functions of one complex variable.

**DEPARTMENT OF MATHEMATICS
UNIVERSITY OF ALLAHABAD**

B.Sc./ B.A. (Semester - 6)

PAPER 3: ADVANCED MECHANICS-II

Velocity and acceleration of a moving particle in Cylindrical and Spherical polar coordinates.

HYDRODYNAMICS: Lagrangian and Eulerian approaches, Equation of continuity in different coordinates systems, boundary surfaces, velocity potential, stream lines.

Euler's equation of motion, steady motion, Bernoulli's equation, impulsive motion.

Motion in two dimensions, stream function, irrotational motion, complex potential, sources and sinks, doublets, image system of a simple source with respect to plane, a circle and a sphere, image system of a doublet with regard to a plane, a circle and a sphere, Circle Theorem.

Books Recommended:

1. S. L. Loney: Dynamics of a Particle and of Rigid Bodies.
2. A. S. Ramsey: A Treatise on Hydrodynamics.

**DEPARTMENT OF MATHEMATICS
UNIVERSITY OF ALLAHABAD**

B.Sc./ B.A. (Semester - 6)

PAPER 4 : NUMERICAL METHODS-II

Numerical Differentiation and Integration: Differentiation using interpolation formulas, Quadrature formulas, Trapezoidal and Simpson's One-third and Three-eight rules.

Numerical Methods for ODEs: First order equations, Incremental Methods: Euler's, Taylor series and Improved Euler methods, Runge-Kutta method, Multistep methods, Predictor corrector pairs: Adam-Bashforth-Moulton's and Milne's formulas, Second order equations: Taylor series and Runge-Kutta-Nystrom Method.

Numerical Linear Algebra: Solution of System of equations: Gauss Elimination, LU-factorization, Cholesky's method, Gauss-Jacobi and Gauss-Seidel iteration formulas, Curve fitting by Least Square method, Estimation of Eigenvalues by Gershgorin circles, Determination of eigenvalues and eigenvectors by iteration (Power method).

Books Recommended:

1. E. Kreyszig: Advanced Engineering Mathematics.
2. K. Sankara Rao: Numerical Methods for Scientist and Engineers.
3. S. S. Sastry: Introductory Methods of Numerical Analysis.
4. Jain, Iyengar and Jain: Numerical Methods for Scientific and Engineering Computation.
5. F. B. Hildebrand: Numerical Analysis.