

Syllabus for courses of study
B.A/B.Sc. Mathematics (Three Year Degree Course)
For 2010-2014

Paper: A (MM-101): DIFFERENTIAL CALCULUS AND COMPLEX TRIGONOMETRY

Paper: B (MM -102) :GEOMETRY(PLANE AND SOLID)

Paper: A (MM -201) :INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS

Paper: B (MM -20)2 :MATRIX THEORY AND THEORY OF EQUATIONS

Paper: A (MM -301): REAL ANALYSIS AND ADVANCED CALCULUS

Paper: B (MM -302): ABSTRACT ALGEBRA

MATHEMATICS
Paper: A(MM-101)
DIFFERENTIAL CALCULUS AND COMPLEX TRIGONOMETRY

Time: 3Hours

Marks:75

Differential Calculus

Unit I

Limit of a function. Basic properties of limits, Continuity and basic properties of continuous functions on closed intervals, combination of continuous functions, Boundedness (and attainment of bounds) of a continuous function in a closed interval. Differentiation, Rolle's Theorem with proof and its applications. Lagrange's Mean value theorem and Cauchy's Mean value theorem with applications. Taylor's and Maclaurin's theorem with applications. Indeterminate forms and L'Hospital's rule (with proof), Successive differentiation and Leibnitz theorem, Intermediate value theorem for continuous functions. Darboux intermediate value theorem for the derivative.

Unit II

Tangents and normals (polar co-ordinates only). Pedal equations, length of arcs. Partial differentiation of functions of two and three variables. Euler's theorem on homogeneous functions. Curvature, radius of curvature for Cartesian and polar coordinates, double points, Asymptotes, Cartesian and polar coordinates, envelopes, involutes and evolutes, tracing of curves(Cartesian coordinates only).

Complex Trigonometry

Unit III

Review of complex number system, triangle inequality and its generalization. Geometrical representation of complex numbers. Equation of a circle and ellipse in complex form, De Moivre's theorem for rational index and its applications, Expansion of $\sin n\theta$, $\cos n\theta$ etc. in terms of powers of $\sin \theta$, $\cos \theta$ and expansion of $\sin^n \theta$ and $\cos^n \theta$ in terms of multiples of θ .

Unit IV

Functions of a complex variable. Exponential, circular, hyperbolic, inverse hyperbolic and logarithmic functions of a complex variable and their properties. Summation of trigonometric series, Difference method, $C + iS$ method.

Books Recommended

- 1.S.D. Chopra and M.L. Kochar and A.Aziz-ul-Auzeem,- Differential Calculus (Thoroughly revised and enlarged new edition- 2004).
- 2.Shanti Narayan,- Differential Calculus
3. Aziz & Nisar-Complex Trigonometry-KBS
- 4.M.R. Puri,-Complex Trigonometry
- 5.Hem Raj,- Pure Mathematics.

Suggested Readings

- 1.T.M.Apostol,- Calculus I
- 2.M.L.Sad,- Complex Trigonometry

MATHEMATICS
(Paper: B(MM -102))
GEOMETRY(PLANE AND SOLID)

Time: 3Hours

Marks:75

Plane Geometry

Unit I

Parabola: Equation of tangent and normal, pole and polar, pair of tangents from a point, equation of a chord of a parabola in terms of its middle point, parametric equations of a parabola. Ellipse; Tangents and Normals, pole and polar, parametric equations of ellipse, Diameters, conjugate diameters and their properties.

Unit II

Hyperbola: Equations of tangents and normals, equation of hyperbola referred to asymptotes as axes, Rectangular and conjugate diameters and their properties. Tracing of conics (Cartesian co-ordinates only). General second degree equation in x and y, conditions under which a general second degree equation represents a conic and determination of equation of the corresponding conic.

Solid Geometry

Unit III

Systems of planes, Two sides of a plane. Bisectors of angles between two planes, joint equation of two planes, Volume of a tetrahedron in terms of co-ordinates of its vertices, Sphere; Definition and equation of a sphere, condition for two spheres to be orthogonal. Radical plane. Coaxial system. Simplified form of the equation of two spheres. Definition of Cone, Vertex, guiding curve, generator, equation of cone with vertex as origin or a given vertex and guiding curve, condition that the general equation of the second degree should represent a cone. Angle between generators of section of a cone and plane through vertex. Necessary and sufficient conditions for a cone to have three mutually perpendicular generators.

Unit IV

Definition of a cylinder, equation of the cylinder whose generators intersect a given conic and are parallel to given line, enveloping cylinder of a sphere. Central conicoids. Tangent lines and tangent planes. Normal to conicoid at a point on it. Normal from a point to a conicoid, polar plane. Shapes and features of the three central conicoids. Diametric planes. Generating lines of ruled surfaces.

Books Recommended:

1. M.R.Puri,- Coordinate Geometry of Conics
2. M.L.Kochar,- Coordinate Geometry
3. Ram Ballabh,- Coordinate Geometry
4. Shant Narayan,- Analytical solid Geometry

Suggested Readings:

1. P. Balasubrahmanyam,- K.G. Subramanian and G.R.Venkataraman,
2. Coordinate Geometry of two and three Dimensions.
3. R.J.T.Bell,- A Text Book of Solid Geometry.

MATHEMATICS
(Paper: B(MM -201))
INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS

Time: 3Hours

Marks:75

INTEGRAL CALCULUS

UNIT-I

Review of the methods of integration, integration of irrational functions, Reduction formulae. Summation of series with the help of definite integrals. Quadrature. Area of a region bounded by a curve, x-axis (y-axis) and two ordinates (abscissa), Sectorial areas bounded by a closed curve. Lengths of plane curves. volumes and areas of surfaces of revolution.

DIFFERENTIAL EQUATIONS

Unit II

Degree and order of a differential equations, Bernoulli's equation, Exact differential equations, Necessary and sufficient conditions for exactness, Symbolic operators. Homogeneous and nonhomogeneous linear differential equations with constant coefficients and those reducible to such equations.

Unit III

Miscellaneous forms of differential equations. First order higher degree equations solvable for x,y,z,p. Equations from which one variable is explicitly absent, Clairut's equation, equations reducible to Clairut's form. Legendre polynomials, Bessel function, recurrence relation and differential equation satisfied by each of these functions.

Unit IV

Functions of several variables: Vector differentiation, Gradient, Divergence and Curl, Beta, Gamma functions and relation between them. Multiple integrals: double integrals, evaluation, change of order of integration for two variables, double integrals in polar co-ordinates, triple integrals, evaluation, triple integrals in cylindrical and spherical polar co-ordinates, change of variables, Jacobian, Green's theorem and problems based on it.

Books Recommended:

1. S.D. Chopra and M.L. Kochar, - Integral Calculus.
2. Shanti Narayan, -Integral Calculus.
3. E.G. Phillips, - Introduction to Differential Equations.
4. Schaum Series, - Differential Equations.
5. Shanti Narayan,- Vector Calculus.

Suggested Readings:

1. T.M. Apostol, - Calculus I
2. H.T.H. Piaggio- Differential Equations.

MATHEMATICS
(Paper: B(MM -202))
MATRIX THEORY AND THEORY OF EQUATIONS

Time: 3Hours

Marks:75

MATRIX THEORY

Unit I

Product of matrices. Transpose of a product of two matrices and its generalization to several matrices. Associative law for the product and Distributive law of matrices. Adjoint of a square matrix A and relation $A(\text{adj.}A) = (\text{adj.}A)A = |A|I$, Inverse of a square matrix. Reversal law for the inverse of a product of two matrices and its generalization to several matrices. A square matrix A possess an inverse if and only if it is nonsingular. The operation of transposing and inverting are commutative. Trace of a matrix, trace of $AB = \text{trace of } BA$, Inverse of partitioned matrices. Inverse of a lower triangular matrices is lower triangular. Matrix polynomials, Characteristic and minimal equations of a matrix. Cayley Hamilton theorem. Rank of a matrix. Elementary row and column transformations of a matrix do not alter its rank. Finding the inverse and rank of matrix by elementary transformations. Reduction of matrix to normal form. Elementary matrices. Every non-singular matrix is a product of elementary matrices. Employment of only row(column) transformations. The rank of a product of two matrices. Linear dependence and linear independence of column (row) vectors.

Unit II

Linear combination: the columns of a matrix A are linearly dependent iff there exists vector $X \neq 0$ such that $AX = 0$. The columns of a matrix A of order $m \times n$ are linearly dependent iff rank of A is less than n . The matrix A has rank r iff it has r linearly independent columns. Analogous results for rows. Linear homogeneous and non-homogeneous equations. The equation $AX = 0$ has a non-zero solution iff rank of A is less than n , the number of its columns. The number of linearly independent solutions of the equation $AX = 0$ is $(n-r)$ where r is the rank of $m \times n$ matrix A . The equation $AX = B$ is consistent iff the two matrices A and $[A:B]$ are of the same rank. Inner product of two vectors. Length of a vector, normal vectors, orthogonal and unitary matrices. A matrix P is orthogonal (unitary) if and only if its columns are normal and orthogonal in pairs. Determination of orthogonal matrices.

THEORY OF EQUATIONS

Unit –III

General properties of equations, synthetic division, Relation between the roots and the coefficients of an equation, Transformation of equations, Diminishing the roots of an equation by a given number, Removal of terms of an equation, Formation of equations whose roots are functions of the roots of a given equation, Equations of squared differences.

Unit-IV

Symmetric functions, Newton's method of finding the sum of powers of the roots of an equation. Cardan's solution of the cubic, nature of the roots of a cubic, Descarte's solution of a biquadratic. Descarte's rule of signs. Rational roots of an integral polynomial. Location of roots of an equation (simple cases).

Books Recommended

1. Shanti Narayan: A Text Book of Matrix.
2. T. Pati: Elements of Matrix Theory.
3. Samuel Borofsky,-Elementary theory of Equations.
- 4 W.S.Burnside and A.W. Panton,- Theory of Equations.
- 5 J.C. Chaturvedi,- Theory of Equations

MATHEMATICS
(Paper: B (MM -301))
REAL ANALYSIS AND ADVANCED CALCULUS

Time: 3Hours

Marks:75

Unit I

Real numbers: Countable and uncountable sets, proof of countability of rationals and of uncountability of reals, Bounded and unbounded sets. L.u.b. and g.l.b. of a set. Completeness and the least upper bound property of the set of real numbers (statements only). Incompleteness of the set of rational numbers.

Sequences of real numbers: Theorems on limit of sequences. Bounded and monotonic sequences. Cauchy's criteria for convergence of sequences. Nested intervals theorem. Bolzano-Weierstrass theorem, Limit inferior and limit superior of a sequence.

Unit II

Infinite series: Convergence and divergence of series, Cauchy criteria for convergence of series. Series of positive terms. Comparison test, Integral test, Cauchy's root test, D-Alembert's ratio test, Raabe's test and Gauss test, absolute and conditional convergence.

Uniform continuity, Uniform continuity of continuous functions on closed and bounded intervals.

UNIT III:

Riemann-Integration: Upper and lower sums, Refinement of a partition, Behaviour of lower sums and upper sums under refinement, Definition and existence of the Riemann integral, Necessary and sufficient condition for R- integrability of a bounded function. R-integrability of sum, difference, product and quotient of two functions, R-integrability of $|f|$ for f which is bounded and R-integrable on an interval. R- integrability of a function having a finite number of discontinuities and of (continuous and) monotone functions, Indefinite integral of a R-integrable function and its basic properties, Fundamental theorem of integral calculus, Mean value theorem for integrals.

Unit IV:

Advanced Calculus: Limit, continuity and differentiability of functions of two or more variables. Directional derivative and total derivative. Sufficient conditions for equality of mixed partials, Change of variables. Extrema of functions of two and of three variables. Restricted maxima and minima.

Books Recommended:

1. Shanti Narayan,- A course in Real Analysis
2. S.C. Malik,- Real Analysis
3. R.R.Goldberg,- Methods of Real Analysis
4. Shanti Narayan,- A text Book of vector Calculus.

Suggested Readings:

1. T.M.Apostol,- Mathematical Analysis.
2. T.M.Apostol,- Calculus II
3. D.Widder,- Advance Calculus (Prentice Hall)

MATHEMATICS
(Paper: B (MM -302))
ABSTRACT ALGEBRA

Time: 3Hours

Marks:75

Unit I

Brief resume of sets, mappings, groups, semigroups and subgroups. Cyclic groups and their subgroups. Cosets and Lagrange's theorem. Product of two subgroups. Counting principle for the number of elements in HK. Normilizer and center.

Unit II

Normal subgroups and various criteria for normality of subgroups; quotient groups. Homomorphism and isomorphism. Fundamental theorem on homomorphism. Correspondence theorem, second and third theorems of isomorphism for groups. Permutation groups , Even and odd permutations, symmetric groups of degree n, Alternating group; simple groups. Cayley's theorem.

Unit III

Rings and fields: Definition and examples of rings, Subrings and subfields. Ring homomorphism, Ideals and Quotient rings. The field of quotients and integral domain. Polynomial rings. Characterization of a ring. Prime and maximal ideals in a ring and their characterization in terms of the associated quotient ring.

Unit IV

Vector spaces and their examples, subspace, criteria for a subset to be subspace, intersection and sum of subspaces of a vector space. Quotient spaces. linear transformations and isomorphism between vector spaces, Algebra of linear transformations, Dual of a vector space, Notion of linear independence and basis of a vector space. Dimension of a vector space. Dimension of the space of linear transformations between finite dimensional vector spaces. Matrix of a linear transformation. Similarity of matrices corresponding to a linear transformation with respect to different bases.

Books Recommended

1. Qazi Zameer-ud-din & Surjeet Singh: Modern Algebra.
2. I.N.Herstein: Topics in Algebra.

Suggested Readings

1. J.B.Fragleh: A Text Book of Modern Algebra.
2. Schaum Series: Modern Algebra.