

## B.A./B.Sc. Part I ( effective from session 2019-2020)

There shall be FOUR compulsory papers. In each paper, there are nine questions in all. Question No. 1 is compulsory with five parts from whole syllabus and rest of the questions are divided into two sections namely Section A and Section B, each of which contains four questions. Students has to answer two questions from each section.

### Paper I: Algebra and Trigonometry

#### Section-A

##### Group Theory

Algebraic Structure, Definition of Group with examples and simple properties. Order of a group. Subgroups and its properties. Transformation, Permutation, Symmetric Set, Permutation Group, Cyclic Permutation, Transposition, Even and odd permutations, The alternating group  $A_n$ , Cyclic Group and Order of an element of a group, Torsion free group, Torsion group or periodic group, Mixed group. Homomorphism, Isomorphism, Transference of group structure theorem. Cayley's theorem. Kernel of Homomorphism, Cosets, Lagrange's theorem, Deduction of Lagrange's theorem. Normal subgroups, Simple Group, Quotient groups. The fundamental theorem of homomorphism.

(3 questions)

##### Algebraic Equations

Transformation of equations. Descarte's rule of signs. Solution of cubic equations by Cardan's method. Solution of biquadratic equations by Descarte's Rule.

(1 question)

#### Section-B

##### Properties of Integers

Divisor, Division algorithm. Greatest Common Divisor, Euclidean algorithm, Fundamental theorem of arithmetic. Congruences and residue classes. Euler  $\phi$  function. Euler's, Fermat's and Wilson's theorem.

(1 question)

##### Trigonometry

De Moivre's theorem, Applications of De Moivre's theorem. Expansion of trigonometrical functions. Exponential, circular, logarithmic, inverse circular, hyperbolic and inverse hyperbolic functions of a complex variable. Summation of trigonometrical series by  $C + iS$  and Difference method, Sum of Series of Hyperbolic Function.

(3 questions)

##### Books Recommended –

1. Contemporary Abstract Algebra by Joseph A. Gallian, Narosa Publication House
2. Advanced Abstract Algebra by Bhupendra Singh, Pragati prakashan
3. A Course In Abstract Algebra by Vijay K Khanna and S K Bhambri, Vikas Publishing House
4. Trigonometry by S.L. Loney, Book Palace Publication New Delhi
5. Theory of Numbers by Sudhir K. Pundir, Pragati prakashan
6. Abstract algebra by A R Vashishtha, Krishna publication.

## **Paper II: Advanced Calculus**

### **Section A**

Limit and Continuity of Functions of Two variables. Partial Differentiation, Euler's Theorem on Homogeneous Functions, Total Derivative, Change of Variables, Expansions of Functions of Two Variables, Taylor's Theorem and Maclaurin's Theorem, Jacobian, Envelopes and Evolutes, Maxima and Minima of Functions of Two Variables. **(4 questions)**

### **Section B**

Beta and Gamma Functions, Multiple Integrals, Change of Order of Integration in Double Integral, Area and Volume by Double Integration. Triple Integral, Dirichlet's Integral, Liouville's Theorem. **(4 questions)**

### **Books Recommended –**

1. Topics in Differential and Integral Calculus: Manju Agarwal & V.S. Verma, NeelKamal
2. Integral Calculus: Vinod Kumar, Epsilon publication
3. Differential Calculus: GC Chadda, Students & friends company
4. Advanced Calculus: Gerald B. Folland, Pearson
5. Integral Calculus, Differential Calculus : Shanti Narayan , P K mittal, S chand publication
6. Integral Calculus: A R vashishtha , Krishna publication

## **Paper III: Differential Equations and Laplace Transform**

### **Section A**

#### **Differential Equations**

Differential Equations of first order and higher degree, Differential equations solvable for  $p$ ,  $y$  and  $x$ . Differential Equation of Clairaut's form, Differential Equations reducible to Clairaut's form, Singular solutions. Geometrical meaning of a differential equation of first order, Differential equation of orthogonal trajectories, Linear differential equations with constant coefficients. Homogeneous linear differential equations, Differential equations reducible to the homogeneous linear form, Simultaneous differential equations. **(4 questions)**

### **Section B**

Linear differential equations of second order with variable coefficients, Transformations of differential equations by changing the dependent and independent variables. Method of variation of parameters. Total differential equations. **(2 questions)**

#### **Laplace Transform**

Existence theorem for Laplace transforms. Properties of Laplace transforms, Laplace transforms of derivatives and integrals, Laplace transforms of unit step and Dirac Delta functions, Inverse Laplace transform, Properties of Inverse Laplace transforms, Inverse Laplace transforms of derivatives and integrals, Convolution Theorem, Solutions of ordinary differential equations using Laplace transform, Solutions of simultaneous differential equations using Laplace transform. **(2 questions)**

#### **Books Recommended –**

1. G.F. Simmons, "Differential Equations", Tata Mcgraw Hill Publishing Company Ltd., 1981.
2. M. D. Raisinghania, "Ordinary and Partial Differential Equations", S. Chand and Company Ltd., New Delhi.
3. M. R. Spiegel, "Laplace Transforms", Schaum's Outline Series, McGraw – Hill Publication, USA.
4. Richard Bronson, Gabriel B. Costa, Ph.D. Schaum's Outline of Differential Equations, 4th Edition (Schaum's Outlines), McGraw-Hill Education
5. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, New York, 2005.

## **Paper IV: Analytical Geometry and Vector Calculus**

### **Section A**

#### **Analytical Geometry**

Co-ordinates, Geometry of Three Dimensions Projections, Direction Cosines, Plane, Straight line, Sphere, Cone, Cylinder, Conicoids, Paraboloid. **(4 questions)**

### **Section B**

#### **Vector Calculus**

Vector Differentiation. Differential Operators : Gradient, Divergence, Curl, Laplacian Operator, Vector Integration, Gauss Divergence Theorem, Stokes Theorem, Green's Theorem in the Plane. **(4 questions)**

#### **Books Recommended –**

1. Geometry and vector calculus, Vinod Kumar, Epsilon publication
2. Geometry and vector calculus, AR Vashishtha, Krishna prakashan
3. Geometry and vector calculus, Sudhir K pundir, Pragati prakashan
4. Analytical geometry, G.C. Chadda, Student,s and Friends&Company
5. Analytical Geometry, D Chatterjee, Narosa Publishing House

## **B.A./B.Sc. Part II ( effective from session 2020-2021)**

There shall be FOUR compulsory papers. In each paper, there are nine questions in all. Question No.1 is compulsory with five parts from whole syllabus and rest of the questions are divided into two sections namely Section A and Section B, each of which contains four questions. Students have to answer two questions from each section.

### **Paper I: AbstractAlgebra**

#### **Section-A**

##### **Rings and Fields**

Introduction to rings, integral domains and fields. Characteristic of a ring. Ring homomorphism. Ideals and quotient rings. Field of quotients of an integral domain. Euclidean rings. Polynomial rings. Polynomials over the rational field. Eisenstein's criteria. Unique factorization domain.

**(3 questions)**

Definition and examples of vector spaces.Subspaces.Sum and direct sum of subspaces.

Linear span. Linear dependence and independence and their basic properties.

**(1 question)**

#### **Section-B**

##### **Vector spaces**

Basis. Dimension. Existence of complementary subspace of a subspace of a finite dimensional vector space.Dimensions of sums of subspaces. Quotient space and its dimension.

**(1 question)**

Linear transformations and their representations as matrices. The algebra of linear transformations. Rank of matrices, Echelon and Normal form of matrices, The rank – nullity theorem. Change of basis.Dualspace. Bidual space and natural isomorphism.

Application of matrices to a system of linear( both homogeneous and non-homogeneous) equations. Theorems on consistency of a system of linear equations.The characteristic equation of a matrix. Eigen values and eigen vectors. Cayley- Hamilton theorem and its use in finding inverse of a matrix. Diagonalisation of square matrices with distinct eigen values.

**(3 questions)**

#### **Books Recommended –**

- 1.Higher Algebra:Abstract and Linear by S K Mapa, Sarat Book House
2. Abstract Algebra:AR Vashishtha, Krishna publication.
3. Linear algebra and Matrices: A R Vashishtha, Krishna Publication.
4. Abstract Algebra: J. Gallian, Narosa publication.
5. Topics in Algebra:I.N.Hersten, John Wiley and Sons

## **Paper II: Real Analysis**

### **Section A**

Lower and upper bounds. Axiom of completeness. Supremum and infimum of the subsets of  $\mathbb{R}$ . Completeness of  $\mathbb{R}$ . Density theorem, Archimedean principle. Definition of a sequence. Theorems on limits of sequences. Bounded and monotonic sequences. Convergence of a sequence. Cauchy's convergence criteria. Bolzano Weierstrass criteria. Limit superior and limit inferior. Convergence of a series. Series of non-negative terms. The number "  $e$  " as an irrational number. Comparison test. Cauchy's  $n^{\text{th}}$  root test. Ratio test. Raabe's test. Logarithmic, De Morgan and Bertrand's tests. Alternating series. Leibnitz test. Absolute and conditional convergences.

**(4 questions)**

### **Section B**

Continuous functions and their properties. Classification of discontinuities. Sequential continuity and limits. Uniform convergence. Differentiability. Chain rule of differentiability. Rolle's theorem. Lagrange's and Cauchy's mean value theorems. Darboux theorem.

**(2 questions)**

Riemann integral. Integrability of continuous and monotonic functions. The fundamental theorem of Integral Calculus. Mean Value theorems of Integral calculus. Convergence of Improper integrals.

**(2 questions)**

### **Books Recommended –**

1. Mathematical Analysis :S.C.Malik & Savita Arora, New Age International (P) Limited.
2. Mathematical Analysis :T.M.Apostol, Addison Wesley.
3. Fundamental Concepts of Analysis :Alton H Smith; Walter A Albrecht, Engle wood cliffs, N.J. Prentice Hall.
4. Real Analysis :Shanti Narayan & Dr. M.D. Raisinghania ,S.Chand & Company Ltd.
5. Real Analysis: H.L.Royden, PHI private Limited, India
6. Introduction to Real Analysis: Robert G. Bartle & Donald R.Sherbert, Wiley India

## **Paper III: Linear Programming and Game Theory**

### **Section A**

Problem Solving and Decision Making, Quantitative Analysis and Decision Making, Developing Mathematical Models, Mathematical Programming, Linear Programming, Convex Sets, Convex and Concave Functions, Theorems on Convexity. Linear Programming Problem (LPP), Simple and General LPP. Solutions of Simple LPP by Graphical Method. Analytical Solution of General LPP, Canonical and Standard forms of LPP. Slack and Surplus Variables. Solution of General LPP by Simplex Method.

**(2 questions)**

Use of Artificial Variables in Simplex Method, Big-M Method and Two-Phase Method.

**(1 question)**

Concept of Duality in Linear Programming, Theorems on Duality, Dual Simplex Method.

**(1 question)**

### **Section B**

Transportation Problem, Balanced and Unbalanced Transportation Problems. Solution of Transportation Problem. Methods for finding Initial Basic Feasible Solution of Transportation Problem, Optimal Solution of Transportation Problem by Modified Distribution (MODI) Method. Degeneracy in Transportation Problem. Maximization Transportation Problem.

**(1 question)**

Assignment Problem. Balanced and Unbalanced Assignment Problems. Solution of Assignment Problem. Hungarian Method. Maximization Assignment Problem. Travelling Salesman Problem.

**(1 question)**

### **Game Theory**

Competitive Game, Two-Person Zero-Sum (Rectangular) Game. Minimax-Maximin Criteria, Saddle Points. Solution of Rectangular Game with and without Saddle Points. Huge Rectangular Games, Dominance Rules. Solution of Huge Rectangular Games using Rules of Dominance, Graphical Method for  $2 \times n$  and  $m \times 2$  Games without Saddle Points.

**(2 questions)**

### **Books Recommended –**

1. An Introduction to Linear Programming and Game Theory: Paul R. Thie & G.E. Keough, A John Wiley and Sons
2. Linear Programming and Game Theory: V.S. Verma, Neelkamal Prakashan
3. Linear Programming and Game Theory: Dipak Chatterjee, PHI Learning Private Limited
4. The theory of Games and Linear Programming: Steven Vajda, Methuen 1956

## **Paper IV: Statics and Dynamics**

### **Section A**

#### **Statics**

Force, Components of force, Parallel forces, Resultant of two forces in a plane, Moment, Couple, Resultant of two couples, Law of parallelogram of forces, Law of triangle of forces, Lami's theorem, Analytical conditions of equilibrium of coplanar forces, Virtual work, Stable and unstable equilibrium, Catenary.

**(4 questions)**

### **Section-B**

#### **Dynamics**

Motion in a straight line: velocity and acceleration, Elastic and inelastic collisions between two objects, The coefficient of restitution, Motion in a plane: velocity and acceleration along radial and transverse direction, velocity and acceleration along tangential and normal directions, Elastic strings, Motion in resisting medium, Projectile motion in resisting medium, Uniform circular motion, Motion on a smooth curve in a vertical plane, Motion in a vertical circle, Simple harmonic motion, Simple pendulum, Cycloidal pendulum. **(4 questions)**

#### **Books Recommended –**

1. S L Loney The Elements of STATISTICS & DYNAMICS Part-I Statics , Arihant .
2. S L Loney The Elements of STATISTICS & DYNAMICS Part-II Dynamics, Arihant.
3. IE Irodov, Fundamental Law of Mechanics (Kindle Edition), CBS Publishers and distributors.
4. M. Ray and G.C Sharma, A Textbook On Dynamics, S. Chand Limited, 2005.



## **B.A./B.Sc. Part III ( effective from session 2021-2022)**

There shall be FOUR compulsory papers, ONE optional paper and a Viva – Voce and Project work based on all the papers read in B.A./B.Sc. Part III .In each paper there are nine questions in all in which question one is compulsory with five parts from whole syllabus and rest of the questions are divided into two sections each of which contains four questions, students has to answer two from each sections.

### **Compulsory Paper**

Paper I : Metric Spaces	50 marks
Paper II : Complex Analysis and Calculus of Variations	50 marks
Paper III : Tensors and Differential Geometry	50 marks
Paper IV : Mechanics	50 marks

### **Optional Paper ( any one of the following )**

Paper V (a) : Programming in C	50Marks = 30 Marks (Theory)+20 marks(Practical)
Paper V (b) : Discrete Mathematics	50 Marks
Paper V (c) : Numerical Methods	50 Marks

### **Viva-voce and Project Work** 50 Marks

There shall be a Viva-voce and a Project work based on the all papers of B.A./B.Sc.Part III (Mathematics). Under the project, the candidate shall present a dissertation. The dissertation will consist of at least two theorems/ articles with proof or two problems with solution, relevant definitions with examples and / or counter examples, wherever necessary, from each paper of Mathematics studied in B.A. / B.Sc. III.

The dissertation will be of 20 marks and the viva-voce will be of 30 marks. For viva-voce and evaluation of project work there shall be a Co-coordinator, an external examiner and an internal examiner. The dissertation will be forwarded by the Head of department at the University centre and by the Principal of the college at the college centre.

# Paper I Metric Spaces

## Section A

Definition of a Metric Space, Examples of Metric Space, Bounded and Unbounded Metric Space, Pseudo-metric, Examples of Pseudo-metric, Subspace of a Metric Space Examples of Subspace of a Metric Space, Diameter of a Subset of a Metric Space, Distance of a Point from a Non-empty set, Distance between two Non-empty Subsets of a Metric Space, Illustrative Examples. **2Questions**

Open and Closed Spheres, Neighbourhood of a point, Interior Point and Interior of a Set, Open sets, Equivalent Metrics, Exterior Point and Exterior of a Set, Frontier Points and Boundary Points of a Set, Frontier and Boundary of a Set, Limit Point and Isolated Point, Derived Set, Closed Set, Closure of a Set, Dense Sets and Separable Spaces, Open and Closed Sets in a Subspace of a Metric Space, Examples. **(2Questions)**

## Section B

Sequence in a Metric Space, Convergence in a Metric Space Cauchy Sequence, Complete Metric Space, Isometry and Isometric Space, Completion of a Metric Space, Function, Continuous Function, Algebra of Real/Complex Valued Continuous Function, Uniform Continuity, Examples. **(1Question)**

Separated Sets, Disconnected Space and Disconnected Sets, Connected Space and Connected Sets, Components, Totally Disconnected Space, Connectedness in the real line, Continuity and Connectedness, Examples. **(1Question)**

Cover, Lindelof Space, Compact Sets and compact Space, Finite Intersection Property and Compactness, Continuity and Compactness, Sequentially Compactness, Compactness and Total Boundedness, Examples. **(2Questions)**

### Books Recommended –

- 1.Metric Spaces: Q.H.Ansari, Narosa Publishing House.
- 2.Metric Spaces: Joydeep Sen Gupta, U.N.Dhur & Sons Private Limited, Kolkata
- 3.Metric Spaces: Micheal O'Searcoid, Springer Verlag, London
- 4.Elementary Theory of Metric Spaces: Robert B.Reisel, Springer Verlag
- 5.Metric Spaces: Edward Copson, Cambridge University Press
- 6.Topology of Metric Spaces:S.Kumaresan, Narosa Publishing House.

## **Paper II Complex Analysis and Calculus of Variation**

### **Section A**

#### **Complex Analysis**

Analytic function. Cauchy-Riemann equations. Harmonic functions. Complex integration. Cauchy's theorem. Cauchy's integral formula. Derivatives. Taylor's series. Laurent's series. Liouville's theorem. Morera's theorem. Zeros and singularities. Poles and residues. Cauchy's residue theorem. Contour integration.

(4 questions)

### **Section B**

Expansion of simple functions in Fourier series. Fourier transform and its simple properties. (2 questions)

#### **Calculus of variations**

Functionals. Variation of a functional. Euler's equation. Case of several variables. Natural boundary conditions. Variational derivative. Invariance of Euler's equation under transformation of coordinates. fixed end point problem for n unknown functions. Variational problem with subsidiary conditions. Isoperimetric problem. Finite subsidiary conditions.

(2 questions)

#### **Books Recommended –**

1. Theory of functions of a complex variable: Shanti Narayan, S.Chand and Co. New Delhi
2. Complex Variable and Applications :R V Churchill and J W Brown, , My Grawhill, New York.
3. Foundation of Complex Analysis S. Ponnuswamy, Narosa Publishing house, India.
4. Calculus of variation:Pundir and Pundir, Pragati Prakashan
5. Function of one Complex Variable:J.B.Conway, Springer International

# Paper III TENSORS AND DIFFERENTIAL GEOMETRY

## Section A

**Tensors:** Transformation of coordinates, Contravariant and covariant vectors, Scalar invariants, Scalar product of two vectors, Tensors of any order. Symmetric and skew-symmetric tensors, Addition and multiplication of tensors, Contraction, composition and quotient law, Reciprocal symmetric tensors of second order.

Fundamental tensors, Associated covariant and contravariant vectors, Inclination of two vectors and orthogonal vectors.

The Christoffel symbols, Law of transformation of Christoffel symbols, Covariant derivatives of covariant and contravariant vectors, Covariant differentiation of tensors.

Curvature tensor and its Identities, Flat Space, Ricci tensor, Einstein space, Einstein tensor .

**(3 questions)**

### Differential Geometry: (Vector Approach)

What is a curve?, Arc length, Reparametrization, Level Curves vs. Parametrized Curves Tangent and Osculating Plane, Principal Normal and Binormal.

**(1 question)**

## Section B

Curvature and Torsion, Behaviour of a curve near one of its points, Curvature and Torsion of a curve as the intersection of two surfaces, Contact between curves and surfaces, Osculating circle and Sphere, Locus of centres of spherical curvature, Plane Curves, Space Curves, Fundamental existence theorem for space curve.

**(1 question)**

What is Surface?, Smooth Surfaces, Tangents, Normals and Orientability, Examples of Surfaces, Quadric Surfaces.

First fundamental form , Length of Curves on Surfaces, Isometries of Surfaces, Conformal of surfaces, Surface Area.

The second Fundamental Form, The Curvature of Curves on a surfaces, The normal and Principal Curvatures, Geometric Interpretation of Principal Curvatures.

**(2 question)**

The Gaussian and Mean Curvatures, The Pseudosphere, Flat Surfaces, Surfaces of Constant Mean Curvature, Gaussian Curvature of Compact Surfaces, The Gauss map.

Definition and Basic Properties of Geodesics, Geodesic Equations.

**(1question)**

### Books Recommended –

1. Elementary Differential Geometry: Andrew Pressley, Springer Publication
2. Tensor Calculus : U.C.De , Narosa Publishing House
3. Tensor and Differential Geometry : P.P.Gupta and G.S.Malik , Pragti Prakashan
4. Differential Geometry ,A First Course: D.Somasundaram,Narosa Publishing House
5. Tensor : Zafar Ahsan , PHI Publication
6. Tensor and differential Geometry : Prasun Kumar Nayak ,PHI Prakashan

## Paper IV Mechanics

### Section A

**Statics:** Forces in three dimensions. Poinsot's central axis. Wrenches. Null lines and null planes. Conjugate lines and conjugate forces. (2 questions)

**Particle Dynamics:** Central orbits. Apses and apsidal distances. Kepler's laws of planetary motion. (1 question)

Motion of a particle in three dimensions. Accelerations in terms of different coordinate systems. Motion on a smooth surface. (1 question)

### Section B

**Rigid Dynamics:** Moments and products of inertia. The momental ellipsoid. Equipmental systems. Principle axes. (2 questions)

D' Alembert's principle. The general equation of motion of a rigid body. Motion of the centre of inertia and motion relative to the centre of inertia. Impulsive forces. (1 question)

Motion about a fixed axis. The compound pendulum. Centre of percussion. (1 question)

### Books Recommended –

1. A Course in Mechanics: Naveen Kumar, Narosa Publishing House
2. Mechanics: Gupta & Malik, Pragati Prakashan
3. Mechanics: P.K. Mittal, S J Publication
4. A Text book of Mechanics: Pande and Singh, Neelkamal Publication

# Paper V(a) Programming in C

## Section A

Introduction to operating system & programming languages, Characteristics of Good program, Procedure for problem solving, Algorithm (Algorithm development, Advantages of Algorithms), Flow Chart (symbols used in Flow-Charts), Logical Structures (Sequential Logic, Selection Logic, Iterative Logic).

C & Its Fundamentals : Introductions, History of C, Features of C, Structure of a C program, The First Program in C (Compilation and Execution of C Program), The C-Character Set, Data types in C (Basic data types ), Identifiers, Variables, Constants / Literals, Reserve Words / Keywords, Library Function , Preprocessor Directives ( #include, #define).

Operators and Expressions: Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Conditional Operator or Ternary Operators (? :), Increment & Decrement Operator, Bitwise Operator, Comma Operator, Size of Operator .

Control Statements in C: Decision Making statements ( if statements, if-else statements, Nested if –else Statements), Selection Statements, Iteration Statements (while Statement, do-while Statement, for Statements), Jumping Statements ( The goto Statement, The return Statement, The break Statement, The continue Statement). **(4 questions)**

## Section B

Arrays in C: Declaration of an Array, Initialization of Array (At Compile Time Initialization, At Run Time Initialization), Types of Array (Single Dimension Arrays, Multi Dimensional Arrays).

Functions in C: Types of Function, Scope of the User Defined Function, Differences between Functions and Procedures, Advanced Featured of Functions ( Function Prototypes, Actual and Formal Parameters or Arguments, Local and Global Variable, Calling Functions by Value or by reference, Recursion), Passing Arrays to a Function (Passing One-Dimensional Array in Function, Passing an Entire One – Dimensional Array to a Function, Passing Multi-Dimensional Array To a Function).

Pointers in C: Definition & Declaration, Null Pointer, Pointer Operators, Passing Pointers to the Functions, Return Pointer from Functions, Array of Pointers (Pointer to Single Dimensional Array, Pointer to Multidimensional Array). **(4 Questions)**

### Books Recommended –

- 1.Programming with C: Byron Gottfried(Schaum's Series),TMH Edition
- 2.C Language and Numerical Methods:C.Xavier, New Age International(P) Limited
- 3.Programming in ANSI C: E Balagurusamy,TMH
- 4.A Text Book of C Programming: A.K.Srivastava & Vijay Kumar, Neelkamal Prakashan

## Paper V(b) Discrete Mathematics

### Section A

**Sets and Propositions:** Cardinality. Mathematical Induction. Principle of inclusion and exclusion.

**Computability and Formal Languages:** Ordered sets. Languages. Phrase Structure Grammars. Types of Grammars and Languages. Permutations. Combinations and Discrete Probability.

**Relations and Functions:** Binary Relations. Equivalence Relations and Partitions. Partial Order Relations and Lattices. Chains and Anti chains . Pigeon Hole Principle.

**Graphs and Planar Graphs:** Basic Terminology. Multigraphs. Weighted Graphs. Paths and Circuits. Shortest Paths. Eulerian Paths and Circuits. Traveling Salesman Problem. Planar Graphs. Trees. **(4 questions)**

### Section B

**Finite State Machines:** Equivalent Machines. Finite State Machines as Language Recognizers.

**Analysis of Algorithms:** Time Complexity, Complexity of Problems. Discrete Numeric Functions and Generating Functions.

**Recurrence Relations and Recursive Algorithms:** Linear Recurrence Relations with constant coefficients. Homogeneous Solutions. Particular Solution. Total Solution. Solution by the Method of Generating Functions. Brief review of Groups and Rings.

**Boolean Algebra:** Lattices and Algebraic Structures. Duality. Distributive and Complemented Lattices. Boolean Lattices and Boolean Algebras. Boolean Functions and Expressions. Propositional Calculus. Design and Implementation of Digital Networks. Switching Circuits.

**(4 questions)**

Books Recommended:

1. Discrete Mathematics: S. Lipschutz & M. C. Lipson (Schaum's Outlines) Mc Graw Hills
2. Discrete Mathematics: H. V. Keshavan, MEDTECH
3. Discrete Mathematical Structures with Application to computer Science: J. P. Tremblay & R. Manohar, Mc Graw Hill Education

## Paper V(C) Numerical Methods

### Section A

Errors in Numerical Calculations. Calculus of finite differences: Delta ( $\Delta$ ),  $E$ , inverted delta ( $V$ ) and  $D$  operators. Forward, Backward and Central differences, The fundamental theorem of finite differences.

Curve Fitting: Fitting of a straight line, Nonlinear Curve Fitting. **(2 questions)**

**Interpolation:** Newton's formulae for interpolation (forward and backward) for equal intervals. Central difference interpolation formulae: Gauss Central difference formulae, Stirling formulae, Bessel formulae and Everett formulae. Interpolation with unequal intervals: Lagrange's interpolation formulae, Newton's divided difference interpolation formulae.

**(2 questions)**

### Section B

**Solutions of Algebraic and Transcendental Equations:** Bisection, Iteration, Regula- Falsi and Newton- Raphson methods, Ramanujan's Method, The Secant method, Solution of system of Non-linear equations. Numerical differentiation, Errors in Numerical differentiation

**(2 questions)**

**Numerical Integration:** Trapezoidal, Simpson's one-third, Simpson's three- eighth and Weddle's rules. Gauss- Legendre quadrature formula.

**Numerical Solution of ordinary differential equations**

Taylor's series method, Picard's method, Euler's method, Euler's modified method, Milne's method and Runge- Kutta method. Initial and Boundary-value problems

**(2 questions)**

### Books Recommended –

1. Introductory Methods of Numerical Analysis : S.S. Shastri, PHI New Delhi
2. Numerical Methods: M.K. Jain, S.R.K. Iyengar, R.K. Jain , New Age International (P) Limited Publisher, New Delhi
3. Numerical Analysis: Francis Scheid, The McGraw Hill Company
4. Numerical Analysis: Bhupendra Singh, Pragati Edition
5. Numerical Analysis: Rama Bhat and Ashok Kaushal, Narosa Publishing house , New Delhi