

Govt. Kamla Raja Girls Post Graduate (Autonomous) College,

Gwalior, M.P.

M.Sc. (Mathematics) Session ~~2015-16~~

~~2017-18~~

~~2018-19~~

2019-2020

Scheme

Session- Nov-Dec-~~2015~~

~~2018~~

Semester I

2019

Paper No.	Paper code and Title	Marks
First Paper	Advanced Abstract Algebra	85 Ext+15 CCE = 100
Second Paper	Analysis	85 Ext+15 CCE = 100
Third Paper	Integral Transform	85 Ext+15 CCE = 100
Fourth Paper	Computer Fundamental and Programming 'c'	85 Ext+15 CCE = 100
Practical	Lab: Practical with Programming In C	100

Session - April - May - ~~2016~~

~~2018~~

Semester II

~~2019~~ - 2020

Paper No.	Paper code and Title	Marks
First Paper	Complex Analysis	85 Ext+15 CCE = 100
Second Paper	Differential Equations	85 Ext+15 CCE = 100
Third Paper	Topology	85 Ext+15 CCE = 100
Fourth Paper	Numerical Method	85 Ext+15 CCE = 100
Practical	Lab : Practical with Programming In C++	100

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Govt. Kamla Raja Girls Post Graduate (Autonomous) College,
Gwalior, M.P.

M.Sc. (Mathematics) Session ~~2015-16~~
~~2017-18~~

~~2017-18~~
2018-19
2019-2020

Scheme

Session- Nov-Dec-2015

Semester III

~~2017~~
2018/19
~~2019~~

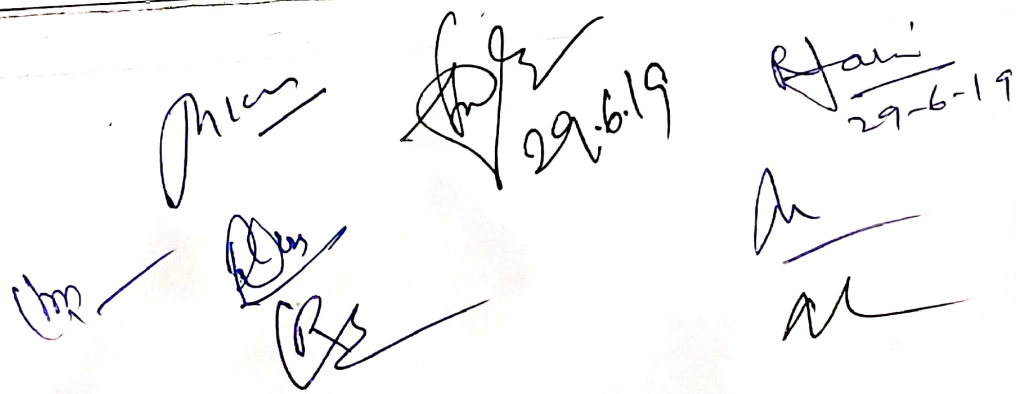
Paper No.	Paper code and Title	Marks
First Paper	Functional Analysis	85 Ext+15 CCE = 100
Second Paper	Integral Equations and boundary value problem	85 Ext+15 CCE = 100
Third Paper	Operation Research	85 Ext+15 CCE = 100
Fourth Paper	Advanced Numerical Methods	85 Ext+15 CCE = 100
Fifth	Practical Lab: Practical based on Numerical Methods	100

Session - April - May - 2016

Semester IV

~~2018~~ 2020

Paper No.	Paper code and Title	Marks
First Paper	Partial Differential Equations	85 Ext+15 CCE = 100
Second Paper	Advanced Graph Theory	85 Ext+15 CCE = 100
Third Paper	Discrete Mathematical Structures	85 Ext+15 CCE = 100
Fourth Paper	Special Functions	85 Ext+15 CCE = 100
Fifth	Internship / Project	100



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Govt. K.R.G. P.G. (Auto) College, Gwalior

M. Sc. I Semester

Subject Mathematics

Nov-Dec ~~2015~~

Paper I

Marks- (85, 15)

~~2017~~ 2018

2019

ADVANCED ABSTRACT ALGEBRA

Unit- I

Sylows First, Second and Third theorems, p-sylow Subgroups, Double cosets conjugate groups, Normal and Subnormal series, Composition series, Jordan Holder theorem, Solvable groups, and commutator subgroups.

Unit- II

Modules, Cyclic modules, Simple modules, finitely generated modules, Fundamental structure theorem for finitely generated modules.

Unit- III

Field theory, Extension fields, Algebraic Extensions, Roots of polynomials, Simple extension, Splitting fields.

Unit- IV

Elements of Galois theory, Fixed Fields, Normal extensions, Group of automorphisms, Galois group, Fundamental theorem of Galois theory.

Unit- V

Canonical forms, Similarity of Linear Transformations, Invariant Subspaces, Nilpotent transformations, Reduction of triangular form, Invariants, Jordon blocks & Jordon normal forms.

Text Books:

1. Topics in Algebra by I.N. Herstein, Wiley Eastern Ltd. New Delhi, 1975.
2. Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
3. Algebra by M. Artin, Prentice-Hall of India 1991.

Reference Books:

1. Algebra by P.M. Cohn, Vols. I, II & III, John Wiley & Sons, 1982, 1989, 1991.
2. Basic Algebra, Vols. I & II by N. Jacobson, W.H. Freeman, 1980 (also published by Hindustan Publishing Company).
3. Galois Theory by J.P. Escofier, GTM, Vol.204, Springer, 2001.
4. Lectures on Modules and Rings by T.Y. Lam GTM Vol, 1990.

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ANALYSIS

Unit- I

Metric spaces: compact sets, perfect sets, connected sets, Compactness and completeness, limit and continuity of function defined on metric spaces, limits of functions, continuous functions.

Unit- II

Continuity and Compactness, continuity and connectedness, monotonic functions: definition and existence of Riemann – Stieltjes integral, properties of the integral, integration and differentiation, the fundamental theorem of calculus, integration of vector-valued functions.

Unit- III

Sequence & Series of function point wise & uniform Convergence, Cauchy Criterion for uniform convergence, Weierstrass M- Test uniform Convergence of Series, Uniform Convergence & differentiation, Weierstrass approximation theorem.

Unit- IV

Lebesgue outer measure, measurable sets & its properties, Borel set & their measurability, Non-measurable set, measurable functions, characteristics function & simple function.

Unit- V

Lebesgue integral of bounded function over a set of finite measure, Integration of Non-negative function, The general Lebesgue integral, Monotonic Convergence theorem, Lebesgue convergence theorem, Fatou's Lemma.

Text Books:

1. Principles of Mathematical Analysis by Walter Rudin.
2. Real Analysis (UNIT IV & V) by H. L. Roydon.

Reference Books:

1. Mathematical Analysis by Mullick & Arora, New Age International Publisher.
2. Lebesgue Measure & Integration by Jain & Gupta. New Age International.

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Marks- (85, 15)
Integral Transforms

Unit-I

Laplace Transforms, Properties of Laplace Transforms, Laplace Transform of the derivatives of function, Inverse Laplace transform, Properties of inverse Laplace transform, Inverse Laplace transform of derivatives, convolution theorem, Heaviside's expansion theorem.

Unit- II

Application of Laplace Transform to solution of differential equations; solutions of initial value problems, solution of differential equations with constant coefficients, Solution of system of two simultaneous differential equations, Application of Laplace Transform to the solution of integral equations with convolution type kernel.

Unit- III

Applications of Laplace Transform to the solution of initial-boundary value problems:- solution of Heat equation, solution of wave equation. Solution of Laplace equation.

Unit- IV

Fourier Transforms, Fourier sine transform, Fourier cosine transform, inverse Fourier Transform, Inverse Fourier sine Transform, Inverse Fourier cosine Transform, Properties of Fourier Transforms, Modulation theorem, Convolution theorem, Fourier Transform of the derivatives of functions, Parseval's identity.

Unit-V

Application of Fourier Transforms to the solution of initial- boundary value problems:- solutions of Heat equation, solution of diffusion equation, solution of wave equation, solution of Laplace equation.

Text Books:

1. Integral Transforms by Vashishtha and Gupta.

Reference Books:

1. Integral Transforms by Sneddon.
2. Integral Transforms by Goyal & Gupta

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COMPUTER FUNDAMENTAL AND PROGRAMING IN C

UNIT- I

An overview of functioning of a computer system, Components of a computer system, I/O and auxiliary storage devices, machine and high level languages, assembler compiler and interpreters, flow charts and pseudo codes, Basic concepts of operating system.

UNIT- II

Introduction to C Essentials – Programs development, Functions, Anatomy of a function, variable and constants expressions. Assignment Statements, Scalar Data types – Declarations, Different types of integer Constants Floating – point type Initialization, mixing types Explicit conversions – casts Enumeration types the void data type, type definitions.

UNIT-III

Operators and expression in C-Precedence and associativity, control flow statements conditional branching, the switch statements, looping, nested loops, the break and continue statement, the go to statement, infinite loops.

UNIT- IV

Arrays and multidimensional arrays, storage classes – fixed vs. automatic duration scope, global variable the register specifier, functions – user defined and library function, Introduction to pointers, structures and unions.

UNIT-V

Introduction to C++: Declaration & Definition of Variables, Data Types, Operators, OOPS Fundamentals: OOPS Versus procedural programming, OOPS terminology, Data abstraction, Data hiding, Encapsulation, Class, Object, Inheritance, Polymorphism.

Text Books:

1. Computer fundamental by Rajaraman
2. Operating systems concepts by Peterson
3. Programming in ANSI C by E. Balaguruswamy, Tata-McGraw Hill, New Delhi.
4. Programming in C++ by E. Balaguruswamy, Tata-McGraw Hill, New Delhi.
5. Schaum's outline series.

Reference Books:

1. Let us C by Y. Kanetkar.
2. Brain W Kernigham & Dennis M Ritchie the C Programmed language 2nd edition (ANSI features) Prentice Hall 1989.

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M. Sc. II Semester

Subject Mathematics

Paper II

Marks- (85, 15)

DIFFERENTIAL EQUATIONS

Unit- I

Preliminaries- Initial value problem and the equivalent integral equation, system of first order ordinary differential equations, concepts of local existence, Existence and uniqueness of solutions of scalar differential Equations, Peano's existence theorem and corollary and scalar case.

Unit- II

System of differential equations, Basic Theorems- Ascoli Arzela theorem, a theorem on convergence of solutions of a family of initial value problems. Picard- Lindel of theorem- Peano's existence theorem and corollary for vector.

Unit- III

Differential Inequalities and integral inequalities- Gronwall's inequality Maximal and Minimal solutions, Differential inequalities Lower and upper function.

Unit- IV

Linear systems of differential equation, characteristic polynomials eigen values, eigen vectors linear homogenous systems and their properties, wronkian, fundamental matrix, Abel-Liouville formula, periodic linear system and Floquet's theorem, Inhomogenous linear systems and variation of constants formula.

Unit- V

Poin care- Bendixson Theory- Autonomous systems, Poin care- Bendixson theorem stability of periodic solutions, foci, nodes and saddle points.

Autonomous system of ordinary differential equations, Phase Plane, critical points, stability, Critical Points and Stability of linear systems, Stability by Liapunov's direct method, Lyapunov functions.

Text Book:

1. Ordinary Differential Equations by M. Ram Mohana Rao, East- West Press.

Reference Books:

1. Ordinary Differential Equations by P. Hartman, John wiley.
2. Theory of ordinary Differential Equations by E.A. Coddington and dSN. Levinson, Mc Graw-Hill, Ny.
3. Differential equations with applications and historical note by G.F. Simmons, Tata McGraw Hill.
4. Ordinary differential Equations by W.T. Reid. John Wiley & sons.

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M. Sc. II Semester

Subject Mathematics

Paper III

Marks- (85, 15)

TOPOLOGY

Unit- I

Topological Spaces: Definition and examples, Open Sets, Closed Sets, Closure neighborhoods, Interior, exterior and boundary, Limit points and derived sets, Basis and Sub basis, Alternate method of defining a topology in terms of Kuratowski Closure operator and Neighborhood systems.

Unit- II

Continuous functions and homeomorphism, Count Ability, First and Second countable Spaces, Lindel of theorem, Separable Spaces, Second count ability and Separability, The product and box topology.

Unit- III

Connected Spaces, Connected Sets in the real line, Components, Path components, local connectedness, Path connectedness, Local Path connectedness.

Unit- IV

Compact Spaces, Lebesgue number lemma, Uniform continuity theorem, Limit point compactness, Local compactness and sequential compactness, one point compactification.

Unit- V

Separation axioms, Hausdroff, Regular and Normal Spaces, The Urysohn lemma, Tietze extension theorem, The Uryshon metrization theorem, Completely regular spaces.

Text Books:

1. Introduction to Topology and Modern Analysis by G.F. Simonons McGraw Hill Book Co.

Reference Book:

1. Topology a first course by James R Munkres, Prentice Hall of India, Pvt. Ltd. New Delhi 2000.
2. General Topology by J.L. Kelley, Van Nostrand, Reinhold Co. New York.

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M. Sc. II Semester

~~Nov-Dec 2015-~~

Subject Mathematics

Paper IV

Marks- (85, 15)

NUMERICAL METHODS

Unit- I

Solution of Algebraic Transcendental & Polynomial equations: Bisection method, Iteration method on first-degree equation: Secant method, Regula-Falsi method, Newton-Raphson method, rate of convergence of Newton-Raphson method & Secant method.

Unit- II

System of linear algebraic equations: Gauss Elimination method, Gauss- Jordan Elimination method, Cholesky method, Iteration methods: Jacobi Iteration method, Gauss-Seidel method.

Unit- III

Interpolation & approximation finite difference operators, Newton's forward and backward interpolation, Central difference interpolation, Lagrange's interpolation, Newton Dividend Difference interpolation, Hermite interpolation, Spline interpolation.

Unit- IV

Differentiation and integration: Numerical differentiation, Numerical integration, Newton-cotes formula, Trapezoidal rule, Simpson's one-third rule, Gauss-Legendre integration method, Lobatto integration method, Rsadau integration method.

Unit- V

Ordinary differential equations- Euler method, Backward Euler method, Midpoint method, Taylor Series method, Runge-Kutta methods, Predictor-Corrector methods.

Text Books:

1. Numerical method for scientific & Engineering Computation by M.K. Jain & R. K. Lyenger & R.K. Jain-Wiley Eastern Ltd.
2. Numerical Method by S.S. Sastry.

Reference Books:

1. Numerical Methods by V. RajaRaman, PHI.

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M. Sc. III Semester
Subject Mathematics

Nov-Dec 2015
2017 2018
Paper I
Marks- (85, 15)

FUNCTIONAL ANALYSIS

Unit- I

Nor med linear spaces, Banach spaces and examples, quotient space of nor med linear spaces and its completeness, convex sets and convex functional, lower semi-continuous and upper semi-continuous functions.

Unit- II

Equivalent norms, Riesz lemma, basic properties of finite dimensional nor med linear spaces and compactness. Nor med linear spaces of bounded linear transformations dual spaces with examples.

Unit- III

Uniform boundedness theorem and some of its consequences open mapping and closed graph theorems Hahn-Banach theorem for real linear spaces and complex linear spaces.

Unit- IV

Reflective spaces, Reflexivity of Hilbert spaces, Inner product spaces, Hilbert spaces. Orthonormal sets, Bessel's inequality, Complete orthonormal sets and Parseval's identity, Structure of Hilbert Spaces, Projection theorem.

Unit-V

Riesz representation theorem, Adjoint of an operator on a Hilbert space. Self-adjoint operators, Positive Projection, normal and unitary operators, Introduction to Sobolev spaces. Fundamental theorem of variational calculus, bilinear forms.

Text Books:

1. Functional Analysis with Applications by A.H. Siddique, Tata McGraw Hill Publishing Company Ltd. New Delhi.
2. Introductory Functional analysis with Applications by Kreyszig John Wiley and Sons, New York.

Reference Books:

1. Real Analysis by H.L. Royden Macmillan Publishing Co. New York, 4th Edition, 1993.
2. Functional Analysis by B.V. Limaye Wiley Eastern Ltd.

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INTEGRAL EQUATIONS AND BOUNDARY VALUE PROBLEMS

Unit-I

Definitions of integral equations and their classification, solution of integral equation, Fredholm integral equations of second kind with separable kernels, solutions of Fredholm integral equation with separable kernel method of successive approximations.

Unit-II

Method of successive substitutions, iterative scheme for Fredholm integral equations of the second kind, resolvent: kernel and its results, application of iterative scheme to Volterra integral equations of the second kind.

Unit-III

Conversion of initial value problem to Volterra integral equation and conversion of boundary value problem to Fredholm integral equation. Conversion of Fredholm integral equation to boundary value problems and conversion of Volterra integral equation to initial value problem.

Unit-IV

Orthonormal system of functions symmetric kernels, fundamental properties of Eigen values and Eigen functions. Green's function for symmetric kernels, Hilbert Schmidt theory and solutions of Fredholm integral equations with symmetric kernels.

Unit-V

Definition of a boundary value problem for an ordinary differential equation of the second order, delta function, Green's function, Green's function approach to reduce boundary value problems of differential equation with homogeneous boundary conditions to integral equations. conditions to reduce

Text Books:

1. Linear Integral Equation Theory and Techniques by R.P. Kanwal Academic Press, New York 1971.
2. Linear Integral Equation (translated from Russian) by S.G. Mikhlin, Hindustan book Agency, 1960.

Reference Books:

1. Boundary value problems of Mathematical Physics by L. Stakgold, Vol. I, II, Mac Millan 1967

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OPERATIONS RESEARCH

Unit- I

Introduction, Nature and Meaning of O.R. Modeling in operations Research. Features of operation research, scope of operations research Linear Programming Problem: formulation of L.P.P. solution of L.P.P. Graphical Method, Simplex Methods in Duality, Integer Programming.

Unit- II

Assignment problems: Mathematical formulation, reduction theorem, unbalanced assignment problem. Transportation problem formulation basic feasible solution North-West-Corner method. Least cost method, Vogel's Approximation method, Optimum solution: MODI method.

Unit- III

Job sequencing: Processing in jobs through 2 machines. Processing in jobs through 2 machines, Processing 2 jobs through a machine. Replacement problems: Replacement policy for items whose maintenance cost increase with time and money value is constant. Money value changes with constant rate.

Unit- IV

Project management: Introduction, network diagram representation, time estimates and critical path with saddle point, rectangular game without saddle point, Principle of dominance, Graphical method.

Unit- V

Queuing Theory: Introduction, queuing system, Transient and steady traffic inlets, Distribution of arrival distribution of departure. M/M/L viz. FCFS model nonlinear programming: Kuhn-Fueker conditions.

Text Books:

1. Linear Programming by G. Hadley, Narosa Publishing House, 1995.
2. Operations Research by R.K. Gupta.

Reference Books:

1. Introduction to Operations Research (sixth edition) by F.S. Hillier and G.J. Lieberman Mc Graw Hill International Edition, Industrial Engineering Series 1995.
2. Operations Research by S.D. Sharma.

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M. Sc. III Semester

Nov-Dec 2015 / 2016

Subject Mathematics

Paper IV

Marks- (85, 15)

ADVANCED NUMERICAL METHODS

Unit- I

Introduction difference calculus, difference operator, linear difference equations, first order equations general results for linear equations. Equations with constant coefficients equations with variable coefficients.

Unit- II

Classification of partial differential equations, Dirichlet's problem, Cauchy's problem. Finite difference approximations to partial derivatives, Elliptic equation, Numerical solutions of Laplace and Poisson equations, Solution to elliptic equations by relaxation method, solution by Laplace equation by Alternating Direction Implicit (ADI) method.

Unit- III

Parabolic equations, Numerical solution of one dimensional diffusion & heat equations. Schmidt method, Crank-Nicholson method, Iterative method-Dafort and Frakel method.

Unit- IV

Hyperbolic equations, the one dimensional wave equation, Numerical solutions of one-dimensional wave equation, Numerical solution of one dimensional wave equation by difference schemes, central-difference schemes, ~~central-difference schemes~~, D'Alembert solution.

Unit-V

Variational finite element method with application to one-dimensional problem, solution of time dependent problems in one dimension and two dimension & steady state problem using Ritz's method.

Text Books:

1. Difference Equation- An Introduction with Application by Walter G. Kelley and Allen C. Peterson, Academic Press Inc., Harcourt Brace Jorandovich Publishers, 1991.
2. Numerical solutions of Differential Equations by M.K. Jain, New Age International (P) Limited, Publishers.

Reference Books:

1. Applied Numerical Analysis by Gerald & Wheatley, Pearson Education.

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Apr-May
: 2019

PARTIAL DIFFERENTIAL EQUATIONS

Unit-I

Introduction, Classification of second order Partial Differential Equations (PDE), Canonical Forms, Boundary Value Problems (BVPS), Properties of Harmonic Functions, Separation of variables

Unit- II

Elliptic Differential Equations, Laplace Equations, Poisson Equations, Dirichlet Problem for a Rectangle. The Neumann Problem for a Rectangle, Interior Dirichlet Problem for a Circle, Exterior Dirichlet Problem for a Circle. Interior Neumann problem for a circle. Solution of Laplace Equation in Cylindrical Coordinates, solution of Laplace Equation in Spherical Coordinates.

Unit-III

Parabolic Differential Equations Diffusion Equations Heat Equations Occurrence of Diffusion Equation, Boundary Conditions, Elementary Solutions of the Diffusion Equation, Dirac Delta Function, Separation of Variables Method Solution of Diffusion Equation in Cylindrical Coordinates, Solution of Diffusion Equation in Spherical Coordinates.

Unit- IV

Hyperbolic Differential Equations Wave Equations, Occurrence of the Wave Equation, Solution of one Dimensional Wave Equation by Canonical Reduction, the initial value problems: D'Alembert Solution, Vibrating String Variables Separable Solution, Forced Vibrations- Solution of Non homogenous Equations.

Unit-V

Duhamel's Principle, Green's Function, Green's Function For Laplace Equation, The method of Images. Green's Function for the Wave Equation-Helmholtz Theorem, Green's Function for the Diffusion Equation.

Books Recommended:

1. Introduction to Partial Differential Equations by K. Sankara Rao, PHI.

Reference Books:

1. Elements of Partial Differential Functions by I.N. Sneddon Mc Graw Hill

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M. Sc. IV Semester

Nov-Dec 2015

Subject Mathematics

Paper II

Marks- (85, 15)

ADVANCED GRAPH THEORY**Unit- I**

Revision of graph theoretic preliminaries, Operations on graphs, Graph Isomorphism disconnected graph and their Components. Traveling salesman problem, round table problem, Konisberg Bridge problem, Eulerian and Hamiltonian Paths and circuits.

Unit- II

Properties of trees, Distance, centre, radius, diameter eccentricity and related theorems, Graph as a metric space, Rooted and binary trees, Labeled graph and trees spanning tree, weighted spanning tree, Shortest path, Fundamental circuits. Rank and nullity, cut sets and cut vertices, Fundamental cut sets.

Unit- III

Connectivity and separability in graphs, Abstract graphs, geometric graphs, planar graphs, Kurtowski two graphs, Embedding and regions of a planar graphs, Detection of Planarity, Geometric dual and combinational dual.

Unit- IV

Coloring and covering of graphs, Chromatic Polynomial, chromatic partitioning, Dimmer problem, Domminating sets, Independent sets, Four colour conjecture.

Unit- V

Digraph and types of digraphs, Digraph and binary relation, Equivalence relation in a graph, Directed path, walk, circuit, and connectedness. Eulerian digraph, arborescence matrices A, B and C of digraph, Adjacency metric of a digraph, Algorithms, Kruskal algorithm, Prism algorithm, Dihkastra algorithm.

Text Book:

1. Graph Theory with Applications to Engineering and Computer Science by Narsingh. Deo.

Reference Book:

1. Graph Theory by Harary.

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DISCRETE MATHEMATICAL STRUCTURES

Unit- I

Relation, Equivalence relation, Partitioning, Fundamental theorem on equivalence relation, ordered sets, First and last elements, maximal and minimal elements, upper and lower bounds, similar sets, Totally ordered sets, well ordered sets, Axioms of choice, Zorn's lemma, Well ordering theorem (statements only), Inclusion exclusion principle & Pigeon Hole principle.

Unit- II

Mathematical logic: Propositions and logical operators, Contradictions and Tautologies, Equivalence & Implication, Duality NAND and NOR connections, Functionally complete sets, Two-state devices and statements logic, Normal forms, Predicate calculus, Free and bound variables.

Unit- III

Lattice-Definition & examples, Distributive lattice, modular lattice, Bounded lattice, complemented lattice, Boolean lattice, Sublattice.

Unit- IV

Boolean algebra-Definition & examples, Basic Boolean algebra laws Principle of duality, Applications of Boolean algebra, Boolean functions, Disjunctive & Conjunctive normal forms, Switching circuits, Minimization of switches.

Unit- V

Mathematical Induction, Recursion, Recursion and iteration, closed form expression, sequence of integers, Recurrence relation, linear recurrence relation, and Homogeneous recurrence, Recurrence relations obtained from solutions, Solving linear homogenous recurrence relation, solving linear non-homogeneous recurrence relations, Generating functions, solution of recurrence relation using generating functions.

Text Books:

1. Discrete Mathematics by N.Ch. S.N. Iyengar, V.M. Chandra Sekharan, K.A. Venkatesh, P.S. Arunachalam- Vikas Publishing House Pvt. Ltd.
2. Set Theory-Schaum outline series.

Reference Books:

1. Discrete Mathematics and its applications by Keneth H. Rosen Tata Mc Graw Hill Pub, Ltd.
2. Discrete Mathematics for Computer Scientists by J.K. Truss, Pearson Education Asia Ltd.
3. Discrete Mathematical Structures with Applications by J.P. Tremblay, R. Manohar DataMc Graw Hill Pub. Company Ltd.

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