

M.Sc. I Semester (Mathematics)

Unit	Paper I: Advanced Abstract Algebra	MM : 35
I	Another counting Principle, Conjugency relation Normalizer, Class Equation Cauchy's theorems, Sylow's theorems, Double cosets, Second and third part of Sylow's theorems, Application of Sylow's theorems in Finite Groups.	7
II	Series of Group : Normal and subnormal series, Composition series, Zassenhaus, Schreir refinement, Jordan-Holder theorem.	7
III	Solvable groups and its properties Commutator subgroup, Nilpotent groups and its properties.	7
IV	Fields: Extension field, Finite extension, Algebraic element, Algebraic and transcendental extension, Roots of polynomials, Splitting field.	7
V	More about roots: Derivative of a polynomial, Simple extension, Primitive element, Separable and inseparable extension, Perfect field, Finite field.	7

Text books :

- 1 I.N. Herstein, Topics in Algebra, Wiley Eastern, New Delhi.
- 2 V.Sahai & V. Bisht, Algebra, Narosa Publishing House

References Books:

- 1 P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra, Cambridge University press.
- 2 N.Jacobson, Basic Algebra, Vol I, II & VIII , Hindustan Publishing Company.
- 3 S.Lang, Algebra, Addison-wesley.
- 4 I.S. Luther & I.B.S. Passi Algebra vol-1,2,3 Narosa company.

M.Sc. I Semester (Mathematics)

MM : 35

Unit	Paper II : Real Analysis	
I	Definition and existence of Riemann-Stieltjes integral and its Properties, Integration and differentiation, The fundamental theorem of Calculus.	7
II	Integration of vector-valued functions, Rectifiable curves. Rearrangements of terms of a series. Riemann's theorem.	7
III	Sequences and series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation theorem, Power series, uniqueness theorem for power series, Abel's and Tauber's theorems.	7
IV	Functions of several variables, linear transformations, Derivatives in an open subset of \mathbb{R}^n , Chain rule, Partial derivatives, interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem.	7
V	Implicit function theorem, Jacobians, extremum problems with constraints, Lagrange's multiplier method, Differentiation of integrals, Partitions of unity, Differential forms, Stoke's theorem.	7

Text books :

- 1 Water Rudin, Principles of Mathematical Analysis, McGraw Hill.
- 2 J.N Sharma and AR Vashishtha - Real Analysis Krishna Prakashan Mandir Meerut (U.P.) [unit - I]

Reference :

- 1 T.M. Apostol, Mathematical Analysis Narosa.
- 2 H.L. Rayden, Real Analysis, Macmillan (Indian Edition)
- 3 Dr H.K. Pathak Real Analysis : Shiksha Sahitya Prakashan Mandir Meerut (U.P.)

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M.Sc. I Semester (Mathematics)

Unit	Paper III : Topology	MM : 35
I	Definition and examples of topological spaces, Basis for a topology, Standard topology, lower limit topology, The order topology, The product topology on $X \times Y$. Projections, The Subspace topology, Closed sets and limit points, Closure and interior of a set.	7
II	Continuous functions, Equivalence with ε - δ condition, Examples of continuous functions, Homeomorphisms, topological property, topological Imbedding, Examples of Homeomorphisms, Rules for Constructing continuous functions, The Pasting lemma, Maps into products, The product topology, Box topology, Projection mapping, comparison of the product topology and the box topology.	7
III	The Metric topology, Metrizable space, Standard bounded metric, The spaces R^n and R^w , Euclidean metric, square metric, Metrizability of R^n and R^w , Uniform metric, The sequence lemma, Uniform limit theorem.	7
IV	Connected space, Separation, Definition and examples, Cartesian product of connected spaces, Connected sets in the real line, Linear continuum, Intermediate value theorem, Path connectedness.	7
V	Compact spaces, Finite product of compact spaces, The Tube Lemma, Finite intersection condition, compact sets in the real line, Maximum and minimum value theorem, Limit point compactness, The Lebesgue number Lemma, Second countable and first countable spaces, Separation Axioms (T_1 , T_2 , T_3 spaces).	7

Text Books :

- 1 J R.Munkres, Topology-Afirst course, Prentice-Hall of India.

References Books:

- 1 G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill
- 2 K.D.Joshi: Introduction to general topology, Wiley Eastern

M.Sc. I Semester (Mathematics)

Unit	Paper IV : Complex Analysis -I	MM : 35
I	Complex integration, Cauchy .Goursat theorem, Cauchy integral formula, Higher order derivatives	7
II	Morera.s theorem.Cauchy's inequality. Liouville.s theorem. The fundamental theorem of algebra. Taylor.s theorem.	7
III	The maximum modulus principle. Schwartz lemma. Laurent series. Isolated singularities. Meromorphic functions, The argument principle. Rouche.s throrem. Inverse function theorem.	7
IV	Residues. Cauchy.s residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to $\arg z$, $\log z$, z^a .	7
V	Bilinear transformations, their properties and classification. Definitions and examples of conformal mappings.	7

Text Book :

- 1 J.B.Convey, Functions of one complex variable, Springer- verlag

References Books :

- 1 S.Ponnuswamy, Foundations of complex analysis, Narosa Publishing House.
- 2 L. V. Ahlfors, Complex analysis, McGraw Hill1979

M.Sc. I Semester (Mathematics)

Unit	Paper V : FUNCTIONAL ANALYSIS	MM : 35
I	Convergence, Completeness and Baire's Theorem, Complete metric spaces. Limit & Limit point. Cantors intersection Theorem, Continuous mappings, Uniformly continuous mapping, examples.	7
II	Spaces of continuous functions, Euclidean and Unitary spaces, Cauchy, Minkowski and Holders inequalities, Normed linear spaces, Examples and elementary properties, quotient spaces. Equivalence of norms, 2-norm, supnorm, p-norm, $1 \leq p < \infty$, Minkowski and Holders inequalities for p-norm, examples.	7
III	Banach space and examples, Continuous linear transformations, norm of an operator, Banach spaces $B(N, N')$. Functionals and their extensions, related Lemma, Hahn-Banach Theorem for normed linear spaces. Conjugates of normed linear spaces..	7
IV	The natural embedding of normed linear space in its second conjugate space, Reflexive Banach spaces, open mapping theorem, Closed graph theorem. Conjugate of an operator, Uniform boundedness principle, examples.	7
V	Inner product spaces, examples, elementary properties of Inner Product, Parallelogram law, Schwartz inequality and polarization identity, Hilbert Space and examples. orthogonal complements in Hilbert spaces. Orthonormal sets, Bessel's inequality, Gram Schmidt orthonormalization process. Conjugate space H^* , Riesz Representation Theorem.	7

Text books:

- 1 G.F. Simmons, Topology and Modern Analysis, McGraw Hill International Edition, 1963.

References Books :

- 1 E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
- 2 R.E. Edwards, Functional Analysis, Dover Publ., New York, 1995. P.K. Jain, O.P. Ahuja and Khalil Ahmed, Functional Analysis, New Age International (P) Ltd. Publ.

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M.Sc. I Semester (Mathematics)

MM : 50

Paper VI : Seminar

M.Sc. II Semester (Mathematics)

Unit	Paper I : Advanced Abstract Algebra	MM : 35
I	The elements of Galois theory: Automorphism of a field, Group of automorphisms of a field, Fixed field, Normal extension, Galois group of a polynomial, Fundamental theorem of Galois theory, Solution of polynomial equations by radicals, Insolvability of the general equation of degree 5 by radicals.	7
II	Introduction to Modules, Examples, Submodules and Direct sum of submodules, R-homomorphisms and Quotient modules, Finitely generated modules, Cyclic module.	7
III	Simple modules, Semi-simple modules, Schur's lemma, Free modules, Rank of a module.	7
IV	Noetherian and Artinian modules, Ascending and Descending chain condition (acc & dcc), Noetherian and Artinian rings, Examples, Hilbert basis theorem.	7
V	Fundamental Structure theorem of finitely generated modules over a Principal Ideal Domain and its applications to finitely generated abelian groups	7

Text books:

- 1 I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1975 (For Unit I).
- 2 M.F. Atiyah and I.G. MacDonald, Introduction to commutative Algebra, Addison Wesley (For Units II, III&IV)
- 3 N. Jacobson, Basic Algebra, Vol. I, Hindustan publishing Company 1991(Chapter 3, For Unit V).
Ramji Lal, Algebra vol II, Shail publication 2002 (Chapter 9, For Unit V).

Reference Books:-

1. S.Singh and Q.Zameeruddin, Modern Algebra, Vikas Publishing House Pvt. Ltd., 1990.
2. I.S.Luther and I.B.S. Passi, Algebra, Vol. II, Narosa Publishing House 1999 (Chapter 13).

M.Sc. II Semester (Mathematics)

Unit	Paper II : LEBESGUE MEASURE AND INTEGRATION	MM : 35
I	Lebesgue outer measure. Measurable sets. Regularity. Measurable functions. Borel and Lebesgue measurability. Non-measurable sets..	7
II	Integration of ,Non-negative functions. The General integral. Integration of Series, Reimann and Lebesgue Integrals.	7
III	The Four derivatives. Functions of Bounded variation. Lebesgue Differentiation Theorem, Differentiation and Integration.	7
IV	The L^P -spaces, Convex functions, Jensen's inequality. Holder and Minkowski inequalities. Completeness of L^P .	7
V	Dual of space when $1 \leq P < \infty$, Convergence in Measure, Uniform Convergence and almost Uniform Convergence.	7

BOOK RECOMMENDED:

- 1 H.K. Pathak - Real analysis - Shiksha Sahitya Prakashan; (Meerut) Ist edition 2003-2004.
- 2 G de. Barra, Measure theory and integration, New Age International(P) Limited New Delhi (Unit III, IV& V)

Reference Books:-

- 1 Walter Rudin, Principle of Mathematical analysis 3rd Edition Mcgraw Hill Kosakusha International Student addition.
- 2 P.K. Jain , V.P. Gupta Lobosque outer Measure Integration Wiley Ester(94

M.Sc. II Semester (Mathematics)

Unit	Paper III(A) : Topology	MM : 35
I	The Tychonoff Theorem, Completely regular spaces, The Stone-Cech compactification.	7
II	Metrization Theorems and Paracompactness, Local finiteness, The Nagata Smirnov Metrization Theorem (Nec & suff), Paracompactness	7
III	Complete Metric spaces & function spaces, Complete metric spaces, A spacefilling curve, Compactness in metric spaces Ascoli's theorem, Pointwise and Compact convergence.	7
IV	The Fundamental Group and covering spaces, Homotopy of paths, the Fundamental Group, Homomorphism, covering spaces, The Fundamental Group of the circle	7
V	Nets & filters : Topology and Convergence of Nets, Hausdorffness & nets, Compactness & nets, Filters and their convergence, Ultra Filters and compactness	7

Text book :

- 1 James R. Munkres, Topology, A First Course, Prentice Hall of India Pvt.Ltd.New Delhi.
- 2 K.D.Joshi, Introduction to General Topology, Wiley Eastern Ltd, New Delhi.

Reference :

- 1 G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company.
- 3 J.Kelly, General Topological, Van Nostrand, New York, 1995.

M.Sc. II Semester (Mathematics)

Unit	Paper III(B) : Ordinary and Partial Differential Equations	MM : 35
I	Exact differential equations and adjoints. The adjoint operator, Lagrange's identity. Sturm-Liouville differential equation, Eigen values, The normal form, Change of independent variables, Lagrange's method of variation of parameter	7
II	Partial differential equations, Construction of partial differential equations of first order, Lagrange's Linear equation, Charpit's general method of solutions Green's functions, Domain and Range of the operators. One dimensional Green's function, Construction of Green's functions	7
III	Power series solutions and special functions, A review of power series, Series solution of first order linear equations, Second order linear equations, Ordinary points. Regular singular points, Gauss's hypergeometric series.	7
IV	Laplace Transforms. Integral transforms, A few remarks on the theory. Conditions for the existence of Laplace transforms, Applications to differential equations	7
V	Derivatives and integrals of Laplace transforms, Convolutions and Abel's Mechanical problems, The unit step and impulse functions.	7

Text book :

- 1 G.F. Simmons Differential equations with applications and historical notes McGraw Hill International Editions, 1991 (for unit 4&5)
- 2 B.P. Parashar Differential Equations

Reference :

- 1 . H.T.H. Piaggio, An Elementary Treatise on differential Equations and Their Applications, Indian Reprint, 1966.
- 2 E.A. Coddington, An Introduction, The Solution of Ordinary Differential Equations, Indian reprint
- 3 B.L. Ince and I.N. Sneddon, The Solution of Ordinary Differential Equations, Longman. 1987.
- 4 Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill Int. Editions, 1957.
- 5 H.T.H. Piaggio, An Elementary, treatise on differential

M.Sc. II Semester (Mathematics)

Unit	Paper IV : Complex Analysis -II	MM : 35
I	Weierstrass factorization theorem, Gamma function and its properties, Riemann zeta function, Riemann's functional equation	7
II	Rung's theorem, Mittag-Leffler's theorem, Schwartz Reflection principle, Analytic Continuation, Analytic Continuation along a path..	7
III	Monodromy theorem and its consequences, Harmonic function, Harmonic functions on a disk, Harnack's inequality and theorem.	7
IV	Dirichlet's problem, Green's function, Jensen's formula, Poisson-Jensen Formula.	7
V	Order of an entire function, Hadamard's three circle theorems, Hadamard's factorization theorem, Bloch's theorem, The Little Picard theorem..	7

Tax BOOK :

- 1 J.B.Convey , Functions of one complex variable, Springer-Verlag

References Books :

- 1 S Ponnuswamy, Fundamentals of complex analysis, Narosa Publishing House.
- 2 L.V.Ahlfors, Complex Analysis, McGraw Hill

M.Sc. II Semester (Mathematics)

Unit

Paper V: **ADVANCED DISCRETE MATHEMATICS**

MM : 35

I	Algebraic Structures : Introduction, Algebraic Systems : Examples and General Properties : Definition and examples, Some Simple Algebraic Systems and General properties, Homomorphism and isomorphism, congruence relation, Semigroups and Monoids : Definitions and Examples, Homomorphism of Semigroups and Monoids.	7
II	Lattices: Lattices as Partially Ordered Sets : Definition and Examples, Principle of duality, Some Properties of Lattices, Lattices as Algebraic Systems, Sublattices, Direct product, and Homomorphism.	7
III	Some special Lattices, e.g. Complete, Complemented and Distributive Lattices, Boolean Algebra: Definition and Examples, Subalgebra, Direct product and Homomorphism, join irreducible, atoms and antiatoms	7
IV	Graph Theory: Definition of a graph, applications, Incidence and degree, Isolated and pendant vertices, Null graph, Path and Circuits: Isomorphism, Subgraphs, Walks, Paths and circuits, Connected graphs, disconnected graphs, and components, Euler graph.	7
V	Trees: Trees and its properties, minimally connected graph, Pendant vertices in a tree, distance and centers in a tree, rooted and binary tree. Levels in binary tree, height of a tree, Spanning trees, rank and nullity..	7

Text Books:

1. J. P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997 (for Units I, II, and III).
2. N. Deo, Graph Theory with Applications to Engineering and Computer Sciences, Prentice Hall of India (for Units IV and V).

Reference Books:

1. C. L. Liu, Elements of Discrete Mathematics, McGraw-Hill Book Co.
2. S. Wiitala, Discrete Mathematics- A Unified Approach, McGraw-Hill Book Co.
3. Seymour Lipschutz, Finite Mathematics, Schaum Series, MGH.
4. J. L. Gersting, Mathematical Structures for Computer Science (3rd ed.) Computer Science Press, New York.

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M.Sc. II Semester (Mathematics)

MM : 50

Paper VI : Comprehensive Viva

M.Sc. III Semester (Mathematics)

Unit	Paper I: Fuzzy Sets and Their Application-I	MM : 35
I	Idea of fuzzy set and membership function, Definition of a fuzzy set, membership function, representation of membership function, General definitions and properties of fuzzy sets, Support, height, equality of two fuzzy sets, containment, examples.	7
II	Union and Intersection of two fuzzy sets, Complement of a fuzzy set, normal fuzzy set, α -cut set of a fuzzy set, strong α -cut, convex fuzzy set, a necessary and sufficient condition for convexity of a fuzzy set (Theorem 1), Decomposition of fuzzy sets, Degree of sub sethood, Level set of a fuzzy set, Cardinality, fuzzy cardinality, examples.	7
III	Other important operations on fuzzy sets, Product of two fuzzy sets, Product of a fuzzy set with a crisp number, Power of a fuzzy set, Difference of two fuzzy sets, Disjunctive sum of two fuzzy sets, example.	7
IV	General properties of operations on fuzzy sets, Commutativity, associativity, distributivity, Idempotent law, identities for operations, Transitivity, involution, Demorgans laws, proofs and examples, Some important theorems on fuzzy sets, set inclusion of fuzzy sets and corresponding α -cuts and strong α -cuts (Theorem 1).	7
V	Comparison of α -cut and strong α -cut, Order relation of scalars α is inversely preserved by set inclusion of corresponding α -cuts and strong α -cuts, α -cut of union and intersection of two fuzzy sets, α -cut of complement of a fuzzy set (Theorem 2), Examples, α -cuts and strong α -cuts of union and intersection of arbitrary collection of fuzzy sets.	7

Text Books :

1 Fuzzy Sets and their Applications by Pundir and Pundir, Pragati Prakashan (PP 30-76).

Reference Books :

1. Fuzzy sets and Fuzzy Logic by G.J. Klir and B. Yuan, Prentice Hall of India, New Delhi, 1995.
2. Fuzzy set Theory and its Applications by H.J. Zimmermann, Allied publishers Ltd, New Delhi 1991.

M.Sc. III Semester (Mathematics)

Unit	Paper II : Advanced Special Function -I	MM : 35
I	Gamma and Beta Functions : The Euler or Mascheroni Constant γ , Gamma Function, A series for $\Gamma'(z) / \Gamma(z)$, Difference equation $\Gamma(z+1) = z\Gamma(z)$,	7
II	Beta function, value of $\Gamma(z) \Gamma(1-z)$, Factorial Function, Legendre's duplication formula, Gauss multiplication theorem.	7
III	Hypergeometric and Generalized Hypergeometric functions: Function ${}_2F_1(a,b;c;z)$ A simple integral form evaluation of ${}_2F_1$ $(a,b;c;z)$, Values of $F(a,b;c;1)$ and $F(-n, b;c;1)$ etc.	7
IV	Contiguous function relations, Hyper geometrical differential equation and its solutions, $F(a,b;c;z)$ as function of its parameters,	7
V	Elementary series manipulations, Simple transformation, Relations between functions of z and $1-z$	7

Text Books :

- 1- Rainville, E.D. ; Special Functions, The Macmillan co., New york 1971,
- 2- Srivastava, H.M. Gupta, K.C. and Goyal, S.P.; The H-functions of One and Two Variables with applications, South Asian Publication, New Delhi.
- 3- Saran, N., Sharma S.D. and Trivedi, - Special Functions with application, Pragati prakashan, 1986.

Reference Books.

- 1- Lebedev, N.N, Special Functions and Their Applications, Prentice Hall, Englewood Cliffs, New jersey, USA 1995.
- 2- Whittaker, E.T. and Watson, G.N., A Course of Modern Anal

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M.Sc. III Semester (Mathematics)

Unit	Paper III : Advance Numerical Analysis -I	MM : 35
I	Piece wise and spline interpolation: Piecewise Linear Interpolation, Piecewise Quadratic Interpolation, Piecewise cubic Interpolation, Piecewise cubic Interpolation using Hermitetype data, Quadratic and cubic spline Interpolation, Bivariate interpolation	7
II	Approximation : Least squares Approximation, Gram-schmitt orthogonalization process, chebyshev polynomials ,legendre polynomials .	7
III	Uniform approximation : Uniform norm , uniform polynomial approximation, best Approximation, best Uniform approximation condition for uniform best approximation .	7
IV	Rational approximation, choice of method, Runge`s example.	7
V	Numerical differentiation: Methods based on interpolation Method, Methods based on finite difference operators , methods based on undetermined coefficients, optimum choice of step length.	7

Text book –

- 1 Numerical Method for scientific and Engineering computation by M.K. Jain, S.R.K. Iyenger, R.K. Jain south Edition (2003) New Age.

Reference Books.

- 1- Atkinson, K. Elementary Numerical Analysis, Wiley New York, 1985

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M.Sc. III Semester (Mathematics)

Unit	Paper IV : Operation Research –I	MM : 35
I	Operations Research and its scope, Origin and Development of Operations Research, Characteristics of Operations Research,	7
II	Model in Operations Research, Phase of Operations Research, Uses and Limitations of Operation Research, Linear Programming Problems.	7
III	Graphical procedure, Graphical solution of property behaved L.P problems. Graphical solution in some exceptional cases.	7
IV	General Linear Programming Problem : Simplex Method exceptional cases, artificial variable techniques ; Big M method, two phase Method and problem of degeneracy.	7
V	Concept of Duality : Definition of Primal-dual problems ,Symmetric Primal-dual problems, Unsymmetric Primal-dual problems, General rules for converting any primal into its dual. Fundamental theorem of duality.	7

Tex Books :-

1-Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi.

Reference Books:-

1-S.D, Sharma, Operation Research,

2-F.S, Hiller and G.J. Lieberman, Industrial Engineering Series, 1995

3-G. Hadley , Linear Programming, Narosa Publishing House. 1995.

4-G. Hadley, Linear and Dynamic programming, Addison - Wesley Reading Mass.

5-H.A. Taha, Operations Research - An introduction, Macmillan Publishing co. Inc. New york.

6-Prem Kumar Gupta and D.S. Hira, Operation Reasearch, an Introduction, S. Chand & Company Ltd. New Delhi.

7-N.S. Kambo, Mathematical Programming Techniques, Affilated East - West Pvt. Lt

M.Sc. III Semester (Mathematics)

Unit	Paper V : INTEGRAL TRANSFORM-1	MM : 35
I	Problem related to Laplace transform Initial and bounding value problems, simultaneous ordinary differential equations. Problem related to solution of partial differential equations. Application of Laplace Transformed in Differential Equations	7
II	Two dimensional Laplace`s Equation (Cartesian and Polar form). Three dimensional Laplace`s Equation to related problems.	7
III	Notion of wave Equation. General solution of wave Equations. Solution by separation of variables. Solution of two dimensional wave equation , three dimensional wave equation.	7
IV	Definition: Integral Equations, problems related to Integral Equations of convolution type. Integral differential equation . Abel`s differential equation	7
V	Notion of Heat Equations. One and two dimensional heat conduction equation. Solution by separation of variables and problems based on it.	7

Text Book :

- 1 Goyal Gupta & Sneddon : Integral Transforms
- 2 Sneddon : Integral Transforms

Reference Book :

- 1 P.R. Halmos : Measure Theory
- 2 I.K. Rana: Measure Theory

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M.Sc. III Semester (Mathematics)

MM : 50

Paper VI : Job - Oriented Project Work

M.Sc. IV Semester (Mathematics)

Unit	Paper I : Fuzzy Sets and their Applications - II	MM : 35
I	Fuzzy sets: Basic Definitions, α-level sets, Convex fuzzy set, Basic operations on fuzzy sets, types of fuzzy sets, Extensions: Types of fuzzy sets, Further operations on fuzzy sets, Cartesian product, Algebraic products, Bounded sum and Difference, t-norm & t-conorm.	7
II	Extension principle and applications, Zadeh extension principle, image and inverse image of fuzzy sets, fuzzy numbers, algebraic operations with fuzzy numbers, extended operation and its properties, Special extended operation, addition, subtraction, product and division of fuzzy numbers.	7
III	Fuzzy relations on fuzzy sets, The union & intersection of fuzzy relations, Composition of fuzzy relations, max-* and max-product compositions, min-max composition and its properties, reflexivity, symmetry, transitivity, and their examples, special fuzzy relations, similarity relation.	7
IV	Fuzzy graphs: Definition and Examples, Fuzzy sub-graph, Spanning sub-graph, path in a fuzzy graph, strength and length of a path, μ-length and μ-distances, connected nodes, fuzzy forest, fuzzy tree, Examples, Fuzzy Analysis: Fuzzy functions on fuzzy sets, classical function, fuzzy function, Examples.	7
V	Fuzzy Logic; An overview of classical logic, Its connectives, Tautologies, Contradiction, Fuzzy logic, logical connectives for fuzzy logic, Examples, Approximate reasoning, its rules, examples, other of implication operations, Linguistic hedges, Fuzzy quantifiers, Examples.	7

Text Books :

1. Fuzzy set theory and its Applications by H.J. Zimmermann, Allied Publishers Ltd., New Delhi, 1991 (For Units I to IV).
2. Fuzzy Logic with Engineering Applications by T.J. Ross, John Wiley & Sons, IInd Ed., 2005 (For Unit V).

Reference Book :

1. Fuzzy sets and Fuzzy Logic Theory & Application by G.J. Klir and B. Yuan, Prentice Hall of India, New Delhi, (2000) .

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M.Sc. IV Semester (Mathematics)

Unit	Paper II - ADVANCED SPECIAL FUNCTION	MM : 35
I	Legendre polynomials : Definition of $P_n(x)$, Generating functions, recurrence relations, Beltrami's result Christoffels summation formula , Murphy formula, Rodrigue's formula Bateman's generating relations and other generating relations.	7
II	Legendre differential equation and its solutions . Laplace first and second integral for $P_n(x)$. Orthogonal properties of Legendre polynomials. Expansion involving Legendre polynomials . Fourier - Legendre Expansion	7
III	Bessel functions : Definition of $J_n(z)$, Generating functions Bessel's differential equation, recurrence relations , Bessel's integral with index half and an odd integer, Orthogonality of Bessel functions	7
IV	Hermite polynomial : Definition of Hermite polynomials $H_n(x)$, Pure recurrence relations, Differential recurrence relations, Rodrigue's formula, Other generating functions, Orthogonality, Expansion of polynomials, more generating functions	7
V	Laguerre Polynomials : The Laguerre Polynomials $L_n(X)$, Generating functions, Pure recurrence relations, Differential recurrence relation, Rodrigue's formula, Orthogonality, Expansion of polynomials, Special properties, Other generating functions.	7

TEXT BOOK :

- 1 Rainville, E.D. ; Special Functions, The Macmillan co., New york 1971,
- 2 Srivastava, H.M. Gupta, K.C. and Goyal, S.P.; The H-functions of One and Two Variables with applications, South Asian Publication, New Delhi.
- 3 Saran, N., Sharma S.D. and Trivedi, - Special Functions with application, Pragati prakashan, 1986

REFERENCE BOOK:

- 1 Lebedev, N.N, Special Functions and Their Applications, Prentice Hall, Englewood Cliffs, New jersey, USA 1995.
- 2 Whittaker, E.T. and Watson, G.N., A Course of Modern Analysis Cambridge University Press, London, 1963

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M.Sc. IV Semester (Mathematics)

Unit	Paper - III : Advanced Numerical Analysis II	MM : 35
I	Extrapolation Methods for Numerical Differentiation. Multistep methods for Numerical Solution of initial value problems. Explicit and implicit Multi step methods.	7
II	General Multistep methods : $\rho(\xi)$ and $\sigma(\xi)$ for linear multiple step methods . Convergence of Multi step methods. Predictor corrector methods.	7
III	Stability analysis of Multistep methods: First order differential Equations, Stability of Predictor- Corrector Methods. Stability of PM_p CM_c methods , second Ordinary Differential.	7
IV	Ordinary differential Equations: Three kind of Boundary conditions . Finite Difference methods, Linear second order differential Equations, Non linear second order differential Equations	7
V	Finite element method : Finite element Ritz Finite element method methods, Linear Boundary Value Problems, mixed boundary conditions	7

Text book :

1 Numerical Method for scientific and Engineering computation by M.K. Jain, S.R.K. Iyenger, R.K. Jain south Edition (2003) New Age.

Reference Book :

1. Fuzzy sets and Fuzzy Logic Theory & Application by G.J. Klir and B. Yuan, Prentice Hall of India, New Delhi, (2000) .

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M.Sc. IV Semester (Mathematics)

Unit	Paper - IV : Operations Research	MM : 35
I	Replacement Problems : Replacement of Items that deteriorate , Replacement policy for items whose maintenance cost increase with time and money value is constant. Money value . present worth factor (PWF) and discount rate . Replacement policy for items whose maintenance cost increase with time and money value with constant rate. Individual Replacement policy, Mortality theorem, Group replacement policy.	7
II	Assignment problems : Mathematical formulation, Fundamental theorems, Hungarian method for assignment problem. Unbalanced assignment problem , The Travelling Salesman (Routing) problem, Job sequencing Processing n Jobs through 2 machines , Processing n Jobs through 3 machines, a graphical method.	7
III	Transportation problems : North - West Corner Method Least - Cost Method. Vogel's Approximation Method, MODI Method, Exceptional cases and problem of degeneracy.	7
IV	Network analysis, constraints in Network, Construction of network, Critical Path Method (CPM) PERT, PERT Calculation, Resource Leveling by Network Techniques and advances of network (PERT/CPM)	7
V	Game theory - Two persons, Zero - Sum Games, Maximix - Minimax principle, games without saddle points -Mixed strategies, Graphical solution of 2xm and mx2 games, Solution by Linear Programming, Non-Linear programming Techniques - Kuhn - Tucker Conditions, Non - negative Constraints	7

TEXT BOOK :

- 1 S.D, Sharma, Operation Research,
- 2 Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi.
- 3 F.S, Hiller and G.J. Lieberman, Industrial Engineering Series, 1995 (This book comes with a CD containing software)
- 4 G. Hadley , Linear Programming, Narosa Publishing House. 1995.
- 5 G. Hadley, Linear and Dynamic programming, Addison - Wesley Reading Mass.
- 6 H.A. Taha, Operations Research - An introduction, Macmillan Publishing co. Inc. New york.

Reference Book :

- 1 Prem Kumar Gupta and D.S. Hira, Operation Research, an Introduction, S. Chand & Company Ltd. New Delhi
- 2 N.S. Kambo, Mathematical Programming Techniques, Affiliated East - West Pvt. Ltd. New Delhi. Madras

Govt. Model Science College (Auto), Jabalpur
Department of Mathematics & Computer Science

M.Sc. IV Semester (Mathematics)

Unit	Optional Paper - V : Integral Transforms-II	MM : 35
I	Application of Laplace Transform to boundary value problems.	7
II	Electric Circuits problems, related to application of Electric Circuits. Application to dynamics, application to heat conduction equation, application to wave equations, Application to Beams.	7
III	The complex Fourier Transform, Inversion Formula, Fourier cosine and sine transform.	7
IV	Properties of Fourier Transforms, Convolution & Parseval's identity.	7
V	Fourier Transform of the derivatives, Finite Fourier Sine & Cosine Transform, Inversion Operational and combined properties Fourier transform.	7

TEXT BOOK :

- 1 H L Royden: Real Analysis, Macmillan Pub. co. inc. Newyork 4th Edition 1993
- 2 Goyal Gupta & Sneddon : Integral Transforms
- 3 Sneddon : Integral Transforms

Reference Books

- 1 P.R. Halmos : Measure theory , van Nostrand
- 2 I K Rana : Introduction to measure and Integration , Narosa Pub. Huse , New Delhi

Year 2017-18

Govt. Model Science College (Auto), Jabalpur
Department of Mathematics & Computer Science

M.Sc. IV Semester (Mathematics)

MM : 100

Paper VI. Comprehensive Viva-Voce

At the end of each Semester a Comprehensive Viva - Voce is to be conducted by a board of at least three examiners which includes at least one external examiner.

Govt. Model Science College (Auto), Jabalpur
Department of Mathematics & Computer Science

M.Sc. III Semester (Mathematics)

Unit	Optional Paper - V : Integral Transforms & Their Application I	MM : 35
I	Integral Transforms : Brief Historical Introduction , Fourier Series and Fourier Transforms ,Gabor Transforms , Basic Concepts and Definitions ,Fourier Transforms and Their Applications :Introduction ,The Fourier Integral Formulas, Definition of the Fourier Transform and Examples ,Fourier Transforms of Generalized Functions, Basic Properties of Fourier Transforms, Poisson's Summation Formula , The Shannon Sampling Theorem , The Gibbs Phenomenon ,Heisenberg's Uncertainty Principle , Applications of Fourier Transforms to Ordinary DifferentialEquations , Solutions of Integral Equations , Solutions of Partial Differential Equations , Fourier Cosine and Sine Transforms with Examples ,Properties of Fourier Cosine and Sine Transforms ,Applications of Fourier Cosine and Sine Transforms to PartialDifferential Equations . Evaluation of Definite Integrals ,Applications of Fourier Transforms in Mathematical Statistics ,Multiple Fourier Transforms and Their Applications	7
II	Laplace Transforms and Their Basic Properties :Introduction , Definition of the Laplace Transform and Examples , Existence Conditions for the Laplace Transform ,Basic Properties of Laplace Transforms ,The Convolution Theorem and Properties of Convolution, Differentiation and Integration of Laplace Transforms ,The Inverse Laplace Transform and Examples ,Tauberian Theorems and Watson's Lemma ,Applications of Laplace Transforms :Introduction,Solutions of Ordinary Differential Equations ,Partial Differential Equations, Initial and Boundary Value Problems , Solutions of Integral Equations 4.5 Solutions of Boundary Value Problems , Evaluation of Definite Integrals , Solutions of Difference and Differential-Difference Equations ,Applications of the Joint Laplace and Fourier Transform ,Summation of Infinite Series , Transfer Function and Impulse Response Function of a Linear System , The Double Laplace Transform, Functional and PartialDifferential Equations	7
III	Fractional Calculus and Its Applications : Introduction, Historical Comments, Fractional Derivatives and Integrals ,Applications of Fractional Calculus.Applications of Fractional Differential and IntegralEquations: Introduction Laplace Transforms of Fractional Integrals and Fractional,Derivatives,Fractional Ordinary Differential Equations ,Fractional Integral Equations ,Initial Value Problems for Fractional Differential Equations . Green's Functions of Fractional Differential Equations , Fractional Partial Differential Equations.	7
IV	Hankel Transforms and Their Applications :Introduction The Hankel Transformand Examples,Operational Properties of the Hankel Transform ,Applications of Hankel Transforms to Partial Differential,Equations Mellin Transforms and Their Applications :Introduction ,Definition of the Mellin Transform and Examples ,Basic Operational Properties of Mellin Transforms ,Applications of Mellin Transforms ,Mellin Transforms of the Weyl Fractional Integral and theWeyl FractionalDerivative ,Application of Mellin Transforms to Summation of Series ,Generalized Mellin Transforms .	7
V	Hilbert and Stieltjes Transforms :Introduction , Definition of the Hilbert Transform and Examples , Basic Properties of Hilbert Transforms ,Hilbert Transforms in the Complex Plane Applications of Hilbert Transforms ,Asymptotic Expansions of One-Sided Hilbert Transforms , Definition of the Stieltjes Transform and Examples ,Basic Operational Properties of Stieltjes Transforms ,Inversion Theorems for Stieltjes Transforms ,Applications of Stieltjes Transforms ,The Generalized Stieltjes Transform Basic Properties of the Generalized Stieltjes Transform .Finite Fourier Sine and Cosine Transforms :Introduction ,Definitions of the Finite Fourier Sine and Cosine Transforms and Examples ,Basic Properties of Finite Fourier Sine and Cosine Transforms ,Applications of Finite Fourier Sine and Cosine Transforms ,Multiple Finite Fourier Transforms and Their Applications	7

TEXT BOOK :

- 1 H L Royden: Real Analysis, Macmillan Pub. co. inc. Newyork 4th Edition 1993
- 2 Goyal Gupta & Sneddon : Integral Transforms, 3 Sneddon : Integral Transforms

Reference Books

- 1 Lok nath Debnath & Dambaru Bhatta Univ.of Texes –Pan AmericanEdinburg USA

Govt. Model Science College (Auto), Jabalpur
Department of Mathematics & Computer Science

M.Sc. IV Semester (Mathematics)

Unit	Optional Paper - V : Integral Transforms & Their Application II	MM : 35
I	Finite Laplace Transforms: Introduction Definition of the Finite Laplace Transform and Examples ,Basic Operational Properties of the Finite Laplace Transform ,Applications of Finite Laplace Transforms ,Tauberian Theorems Z Transforms : Introduction ,Dynamic Linear Systems and Impulse Response ,Definition of the Z Transform and Examples ,Basic Operational Properties of Z Transforms,The Inverse Z Transform and Examples ,Applications of Z Transforms to Finite Difference Equations . Summation of Infinite Series .	7
II	Finite Hankel Transforms : Introduction ,Definition of the Finite Hankel Transform and Examples ,Basic Operational Properties ,Applications of Finite Hankel Transforms. Legendre Transforms :Introduction ,Definition of the Legendre Transform and Examples ,Basic Operational Properties of Legendre Transforms ,Applications of Legendre Transforms to Boundary Value,Problems	7
III	Jacobi and Gegenbauer Transforms : Introduction ,Definition of the Jacobi Transform and Examples ,Basic Operational Properties ,Applications of Jacobi Transforms to the Generalized HeatConduction Problem ,The Gegenbauer Transform and Its Basic Operational Properties , Application of the Gegenbauer Transform.Laguerre Transforms :Introduction ,Definition of the Laguerre Transform and Examples ,Basic Operational Properties ,Applications of Laguerre Transforms.	7
IV	Transforms : Introduction ,Definition of the Hermite Transform and Examples ,Basic Operational Properties . The Radon Transform and Its Applications :Introduction ,The Radon Transform ,Properties of the Radon Transform ,The Radon Transformof Derivatives ,Derivatives of the Radon Transform ,Convolution Theorem for the Radon Transform ,Inverse of the Radon Transform and the Parseval Relation ,Applications of the Radon Transform .	7
V	Wavelets and Wavelet Transforms : Brief Historical Remarks ,ContinuousWavelet Transforms ,The DiscreteWavelet Transform ,Examples of OrthonormalWavelets :Appendix A Some Special Functions and Their Properties :A-1 Gamma, Beta, and Error Functions ,A-2 Bessel and Airy Functions ,A-3 Legendre and Associated Legendre Functions ,A-4 Jacobi and Gegenbauer Polynomials ,A-5 Laguerre and Associated Laguerre Functions ,A-6 Hermite Polynomials and Weber–Hermite Functions ,A-7 Mittag–Leffler Function :Appendix B Tables of Integral Transforms :B-1 Fourier Transforms ,B-2 Fourier Cosine Transforms ,B-3 Fourier Sine Transforms ,B-4 Laplace Transforms ,B-5 Hankel Transforms ,B-6 Mellin Transforms ,B-7 Hilbert Transforms ,B-8 Stieltjes Transforms ,B-9 Finite Fourier Cosine Transforms ,B-10 Finite Fourier Sine Transforms ,B-11 Finite Laplace Transforms ,B-12 Z Transforms ,B-13 Finite Hankel Transforms .	7

TEXT BOOK :

- 1 H L Royden: Real Analysis, Macmillan Pub. co. inc. Newyork 4th Edition 1993
- 2 Goyal Gupta & Sneddon : Integral Transforms
- 3 Sneddon : Integral Transforms

Reference Books

- 1 P.R. Halmos : Measure theory , van Nostrand
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- 3 Lok nath Debnath & Dambaru Bhatta Univ.of Texes –Pan AmericanEdinburg USA