



बिलासपुर विश्वविद्यालय, बिलासपुर (छत्तीसगढ़)

SEMESTER SYLLABUS

M.Sc. MATHEMATICS

SCHEME OF EXAMINATION & DISTRIBUTION OF MARKS

SEMESTER - I

Paper No.	Title of the Paper (s)	Internal Assessment	Term End Exam	Practical	Total Marks
1.	Advanced Abstract Algebra (I)	20	80		100
2.	Real Analysis (I)	20	80		100
3.	Topology (I)	20	80		100
4.	Complex Analysis (I)	20	80		100
5.	Advanced Discrete Mathematics (I)	20	80		100

SEMESTER - II

Paper No.	Title of the Paper (s)	Internal Assessment	Term End Exam	Practical	Total Marks
1.	Advanced Abstract Algebra (II)	20	80		100
2.	Real Analysis (II)	20	80		100
3.	Topology (II)	20	80		100
4.	Complex Analysis (II)	20	80		100
5.	Advanced Discrete Mathematics (II)	20	80		100

SEMESTER - III

Paper No.	Title of the Paper (s)	Internal Assessment	Term End Exam	Practical	Total Marks
1.	Integration Theory and Functional Analysis - I	20	80		100
2.	Partial Differential Equations. Mechanics and Gravitation - I	20	80		100
<b>OPTIONAL PAPER (ANY THREE)</b>					
3.	Program. in C with ANSI Features I	20	50	30	100
4.	Fuzzy Sets and their Applications-I	20	80		100
5.	Operations Research-I	20	80		100
6.	Fluid Mechanics-I	20	80		100
7.	Information Theory-I	20	80		100
8.	Fundamentals of Computer Science -I	20	80		100

SEMESTER - IV

Paper No.	Title of the Paper (s)	Internal Assessment	Term End Exam	Practical	Total Marks
1.	Integration Theory and Functional Analysis -II	20	80		100
2.	Partial Differential Equations. Mechanics and Gravitation - II	20	80		100
<b>OPTIONAL PAPER (ANY THREE)</b>					
3.	Programming in C with ANSI Features- II	20	50	30	100
4.	Fuzzy Sets and their Applications-II	20	80		100
5.	Operations Research-II	20	80		100
6.	Fluid Mechanics-II	20	80		100
7.	Information Theory-II	20	80		100
8.	Fundamentals of Computer Science II	20	80		100

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M.Sc. MATHEMATICS

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SEMESTER-I  
PAPER- I  
ADVANCED ABSTRACT ALGEBRA

**Group-** Permutation group, Normal subgroup, Three Isomorphism Theorems, Correspondence Theorem, Maximum Normal subgroup, Automorphism and Inner Automorphism, Centre of groups.

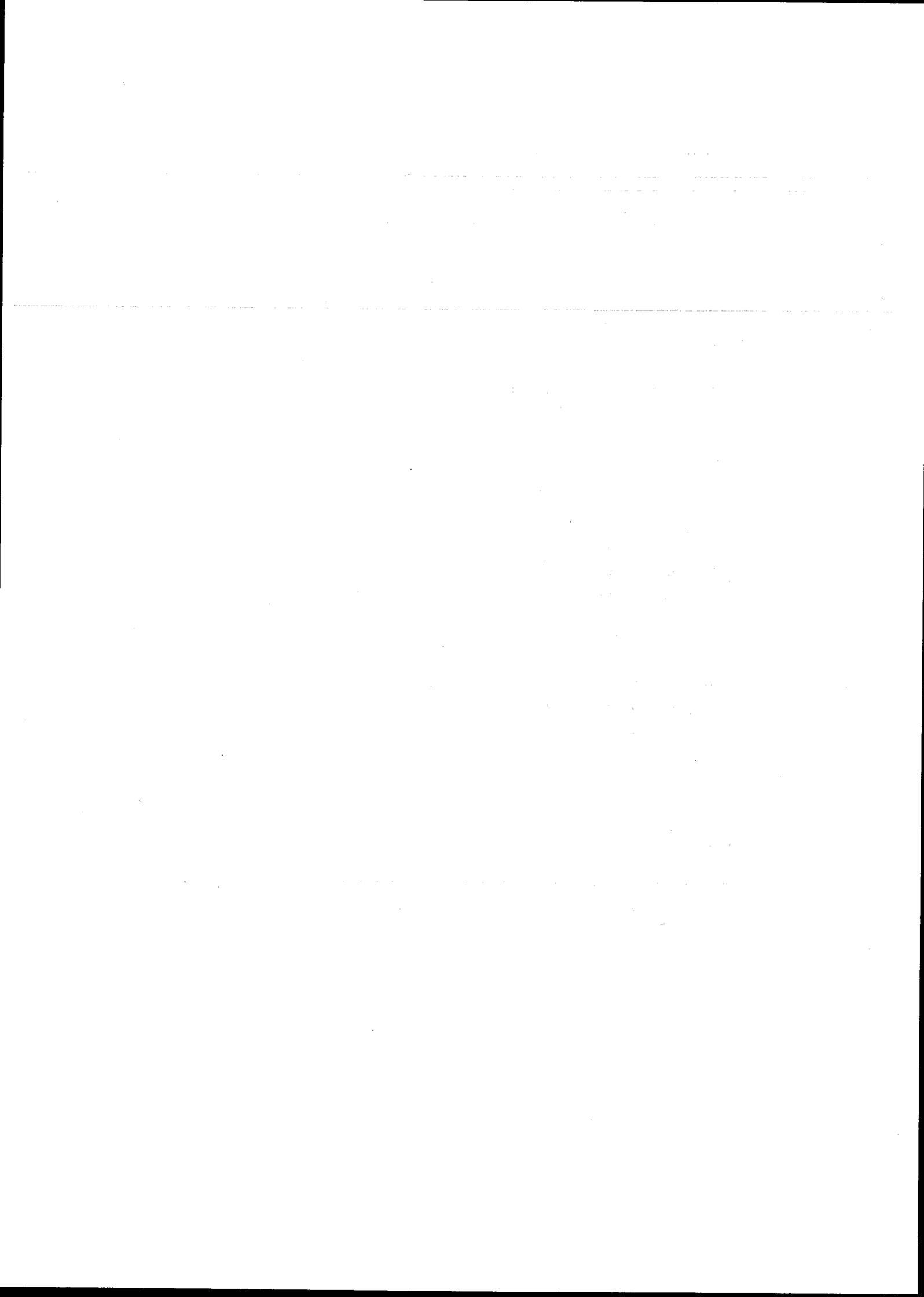
**Normal Series-** Normal and Subnormal series, Composition Series, Jordan-Holder theorem, Solvable groups, Nilpotent groups.

**Rings & Modules-** Definitions, Maximal and prime ideals, Nilpotent and Nil Ideals, Zorn's Lemma (statements only), its application to obtain maximal ideals.

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**REFERENCES:**

1. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul: Basic Abstract Algebra (2nd Ed.), Cambridge University Press, Indian Edition, 1997
2. I.S. Luther and I.B.S. Passi, Algebra: Vol. I - Groups, Narosa Publishing House, 1996.
3. Surjeet Singh and Quazi Zameeruddin: Modern Algebra, Vikas Publishing House Pvt. Ltd., 1990.
4. N. Jacobson: Basic Algebra: Vols. I & II, Hindustan Publishing Company, 1980.
5. S. Lang: Algebra, 3rd Edition, Addison-Wesley, 1993.





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SEMESTER-I  
PAPER-II  
REAL ANALYSIS-I

**The Riemann–Stieltjes Integral-** Definition and existence of Riemann–Stieltjes integral, Properties of the Integral, Integration and differentiation, the Fundamental Theorem of Calculus, integration of vector-valued function Rectifiable curves.

**Functions of Several Variables-** Linear transformation, derivatives in an open subset of  $\mathbb{R}^n$ , Contraction principle, Inverse function theorem, Implicit function theorem, Derivatives of higher orders, Differentiation of integrals.

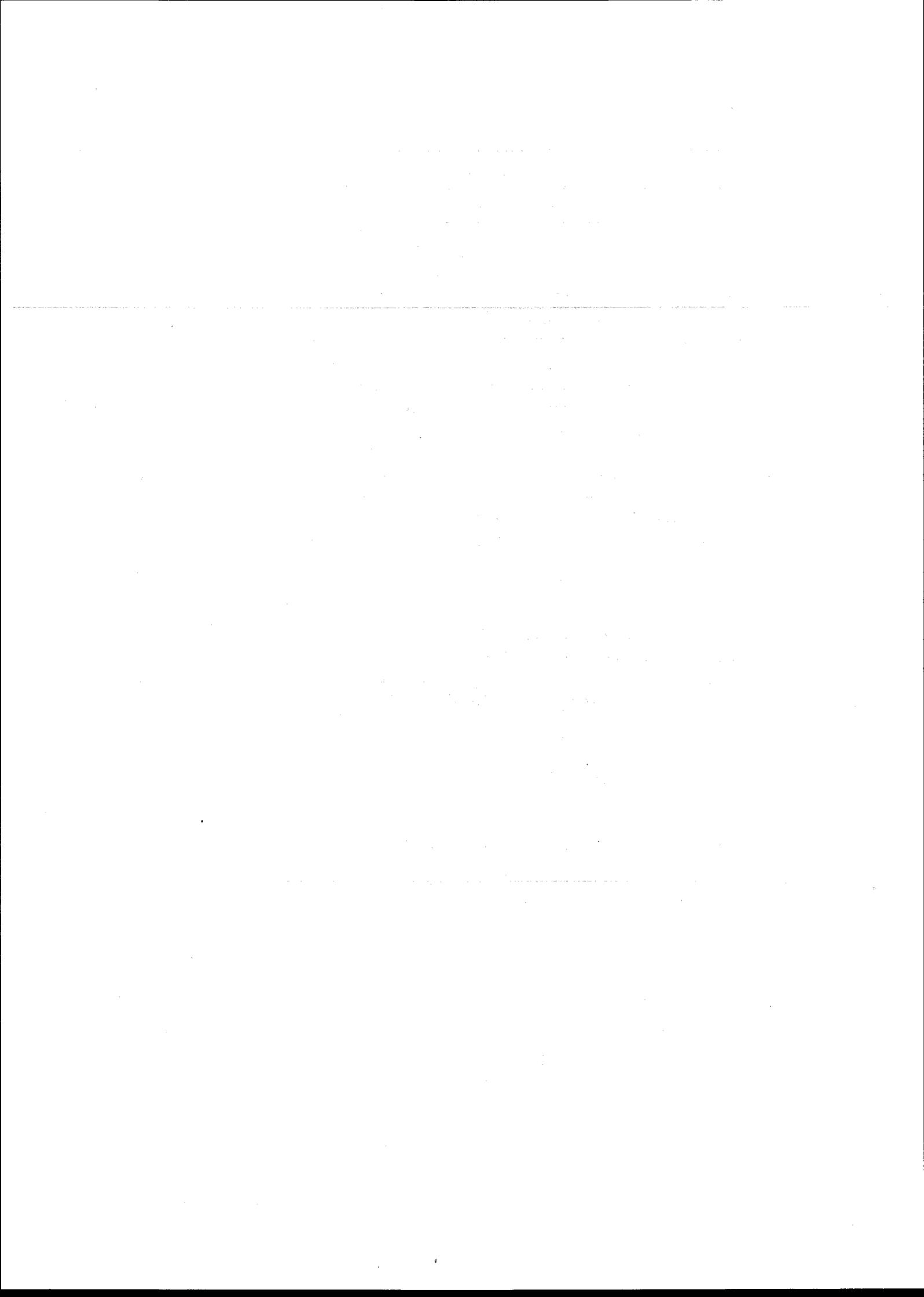
**Sequences and series of Functions-** Point wise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, Uniform convergence and continuity uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation theorem.

**Power Series-** Uniqueness theorem for power series, Abel's and Tauber's theorem.

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REFERENCES:

- [1] Walter Rudin: Principles of Mathematical Analysis' (3rd edition ) McGraw Hill, Kogakusha, 1976, International student edition.
- [2] P.K. Jain and V.P. Gupta: Lebesgue Measure and Integration, New age International (P) Limited published, New Delhi 1986 (Reprint 2000).





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SEMESTER-I  
PAPER-III  
TOPOLOGY – I

Definition and examples of topological spaces, closed sets, Closure, Dense subsets  
Neighborhoods, Interiors, exteriors and boundary points.

Accumulation point and derived set, Bases and sub-base, subspaces and relative  
topology, Alternate methods of defining a topology in terms of Kuratowski Closure  
Operator and Neighborhoods systems.

Continuous functions and Homeomorphism.

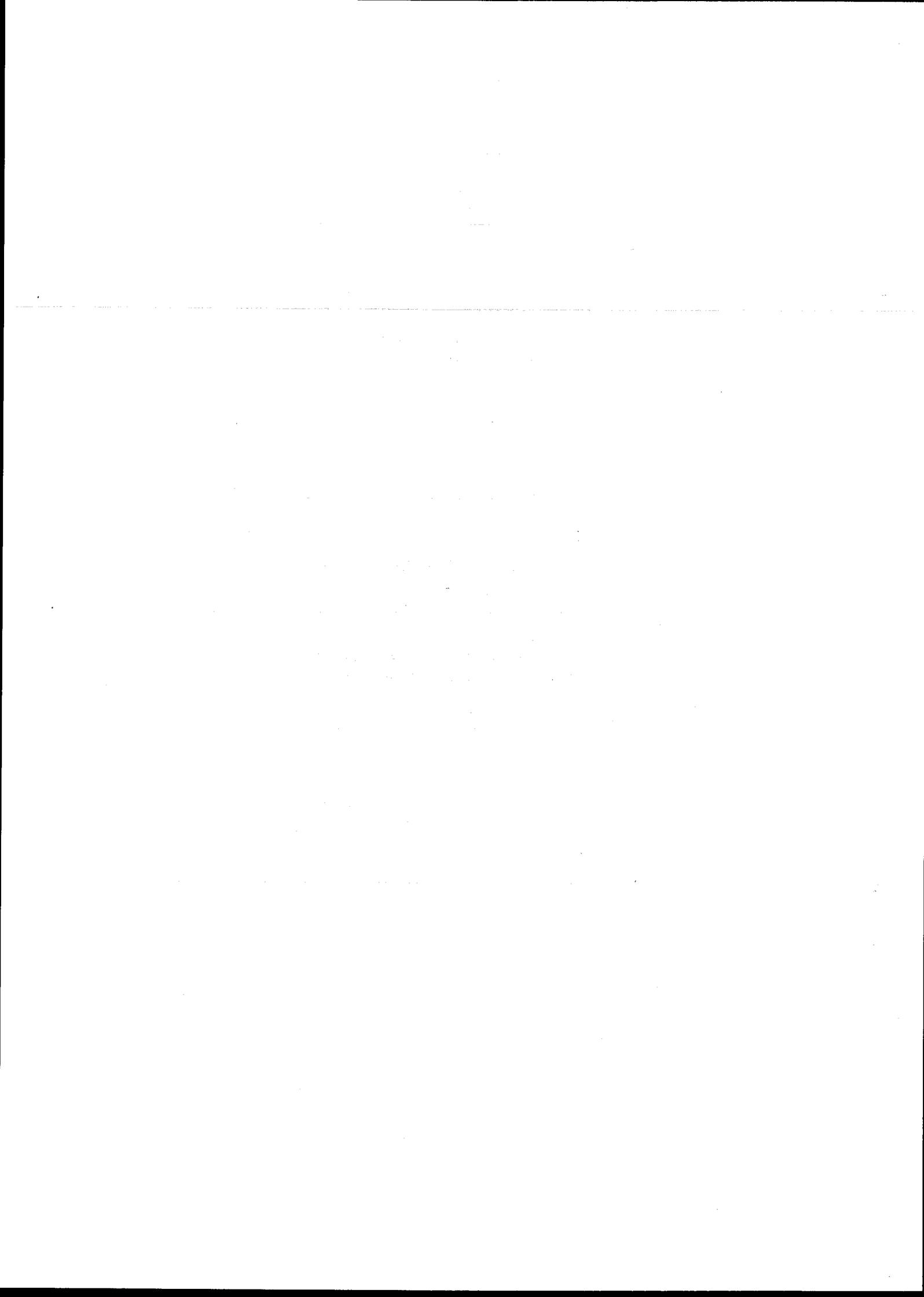
Separation axioms,  $T_0$ ,  $T_1$ ,  $T_2$ ,  $T_3$ ,  $T_{3\frac{1}{2}}$ ,  $T_4$  spaces, their characterization and basic  
properties.

First and second countable countable spaces, Lindelof's theorems, Separable Spaces,  
Second Countability and Separability, Uryshohn's lemma and Tietz Extension Theorem.

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**REFERENCES:**

1. G.F. Simmons: Introduction to Topology and Modern Analysis, McGraw -Hill
2. J.N. Sharma: Topology, Krishna PrakashanMandir, Meerut
3. M.J.Mansfield: Introduction to Topology. **Van Nostrand. Princeton, New Jersey, 1963**
4. Jame R. Munkres. Topology, A First Course. **Prentice Hall, Incorporated, 1974**
5. K.D.Joshi: Introduction to General Topology , New Age International(P) Ltd. New Delhi.
6. JDugundji. Topology. Boston: Allyn and Bacon, 1966. [OP]
7. B.Mendelson: Introduction to Topology, **Dover Publications, 1990.**





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SEMESTER-I  
PAPER- IV  
COMPLEX ANALYSIS- I

Complex Integration, Cauchy-Goursat Theorem, Cauchy's integral Formula, Higher order derivatives.

Morera's theorem, Cauchy inequality and Liouville theorem, the fundamental theorem of Algebra, Taylor's theorem, Maximum modulus principle.

Laurent's series isolated singularities.

Meromorphic functions, Schwarz lemma, the Argument principle, Rouché's theorem Inverse function theorem.

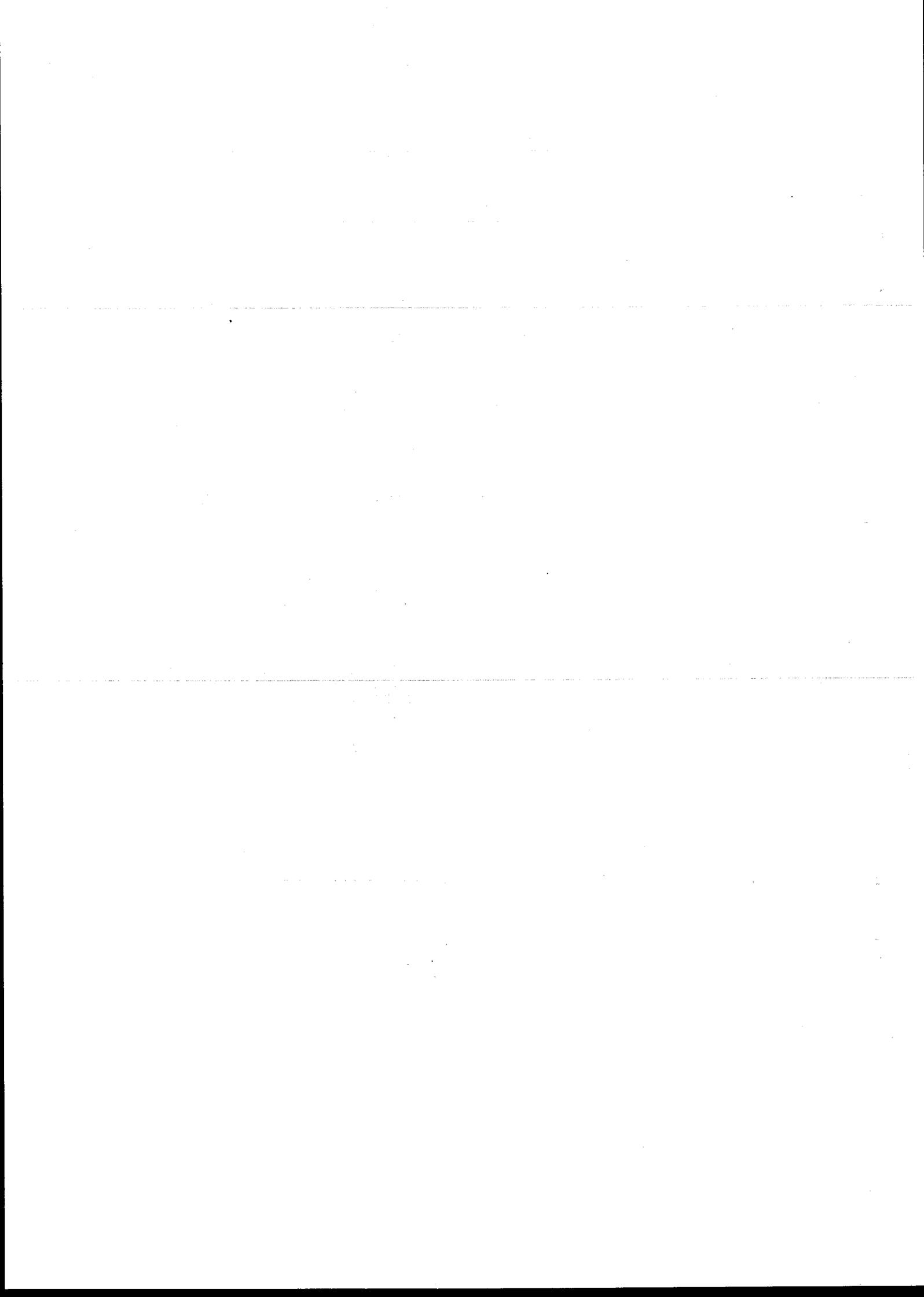
Residues, Cauchy's residue theorem, Evaluation of integrals, Branches of many values functions with special references to  $\arg z$ ,  $\log z$ . And  $z^8$ .

Bilinear transformations, their properties and classification, Definitions and examples of conformal mappings.

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**REFERENCES:-**

1. J.B. Conway : Functions of one complex variable. Springer-Verlag international student Edition. Narosa publishing House. 1980.
2. D. Sarason : Complex Function theory. Hindustan Book Agency. Delhi 1994.
3. S. Ponnusamy : Foundation of complex Analysis. Narosa publishing house 1997.
4. J.N. Sharma : Functions of a complex variable , Krishna Prakashan Mandir, Meerut
5. B.S. Tyagi: Functions of a Complex Variable, Kedar Nath Ram Nath Prakashan, Meerut, 1981.





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M.Sc. MATHEMATICS

SEMESTER-I  
PAPER-V  
ADVANCED DISCRETE MATHEMATICS- I

Formal logic- Statement and Notation, Connectives-- Negation, Conjunction, Disjunction, Truth Table, Conditional and Biconditional statement, well-formed formula, Tautology, Equivalent formula, Duality and functionally complete set of connectives, two state devices and statement logic, Normal form, Principle conjunctive and Principle Disjunctive Normal forms, The theory of interface for the statement calculus, Rules of Interface, Automatic Theorem proving, the predicate calculus, Quantifiers, Rules of Interface, Free and Bound variables, Interface theory of predicate calculus, valid formulas over finite universe, valid formulas involving quantifiers, formulas involving more than one quantifiers.

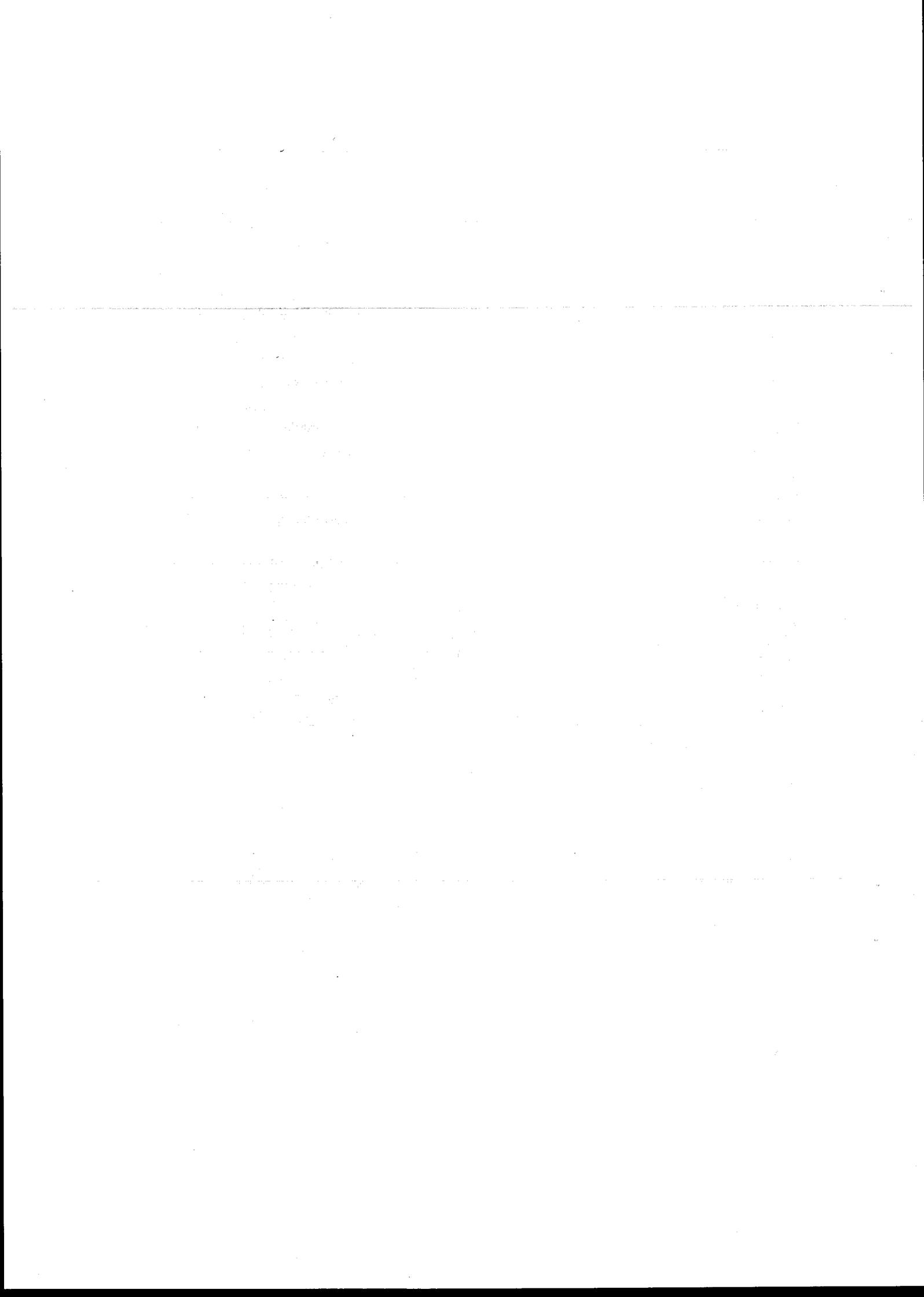
Algebraic Structure - Algebraic system, Semigroups and Monoids (including those pertaining to concatenation operation), Homomorphism of semigroup and SubMonoids. Direct products, Basic Homomorphism theorem.

Lattices - Lattices as partially ordered sets and their properties. Lattices as Algebraic systems, Sub lattices, directproducts and homomorphism, Complete, Complemented and Distributive Lattice

Boolean Algebra- Boolean Algebras as lattices, Various Boolean Identities, The switching Algebra, example, Subalgebras, Direct products and Homomorphism, Join-irreducible elements, Atoms and min-terms, Boolean forms and their Equivalence, Minterm Boolean forms, Sum of products, canonical forms, Minimization of Boolean functions Application of Boolean Algebra to Switching theory (Using AND, OR, NOT gates) The Karnaugh Map Method.

**REFERENCES:**

1. J.P. Tremblay & R. Manohar: Discrete Mathematical structure with application to computer sciences. McGraw Hill Book Co. 1997.
2. Seymour Lipschutz.: Finite Mathematics (International edition 1993) McGraw Hill Book Co. New York.
3. N. Deo: Graph Theory with applications to Engineering and Computer Sciences. Prentice Hall of India.
4. S. Wiitala: Discrete Mathematics - A unified approach McGraw Hill Book Co. New York.
5. C.L. Liu: Elements of Discrete mathematics. McGraw Hill Book Col.
6. M.K.Gupta: Discrete Mathematics, Krishna Prakashan Mandir (P) Ltd., Meerut.





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M.Sc. MATHEMATICS

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SEMESTER-II  
PAPER-I  
ADVANCED ABSTRACT ALGEBRA-II

**Modules and Vector Space** - Definition and examples of sub-modules, Quotient modules, Direct sum, Modules generated by a set  $R$ , Homomorphism of modules, Isomorphism Theorem, exact sequence of modules, short exact sequence Cyclic Modules, Semi Simple Modules, Simple Modules, Schure's Lemma, Free Modules, Representation of Linear mapping, Rank of Linear mapping, Rank Nullity Theorem.

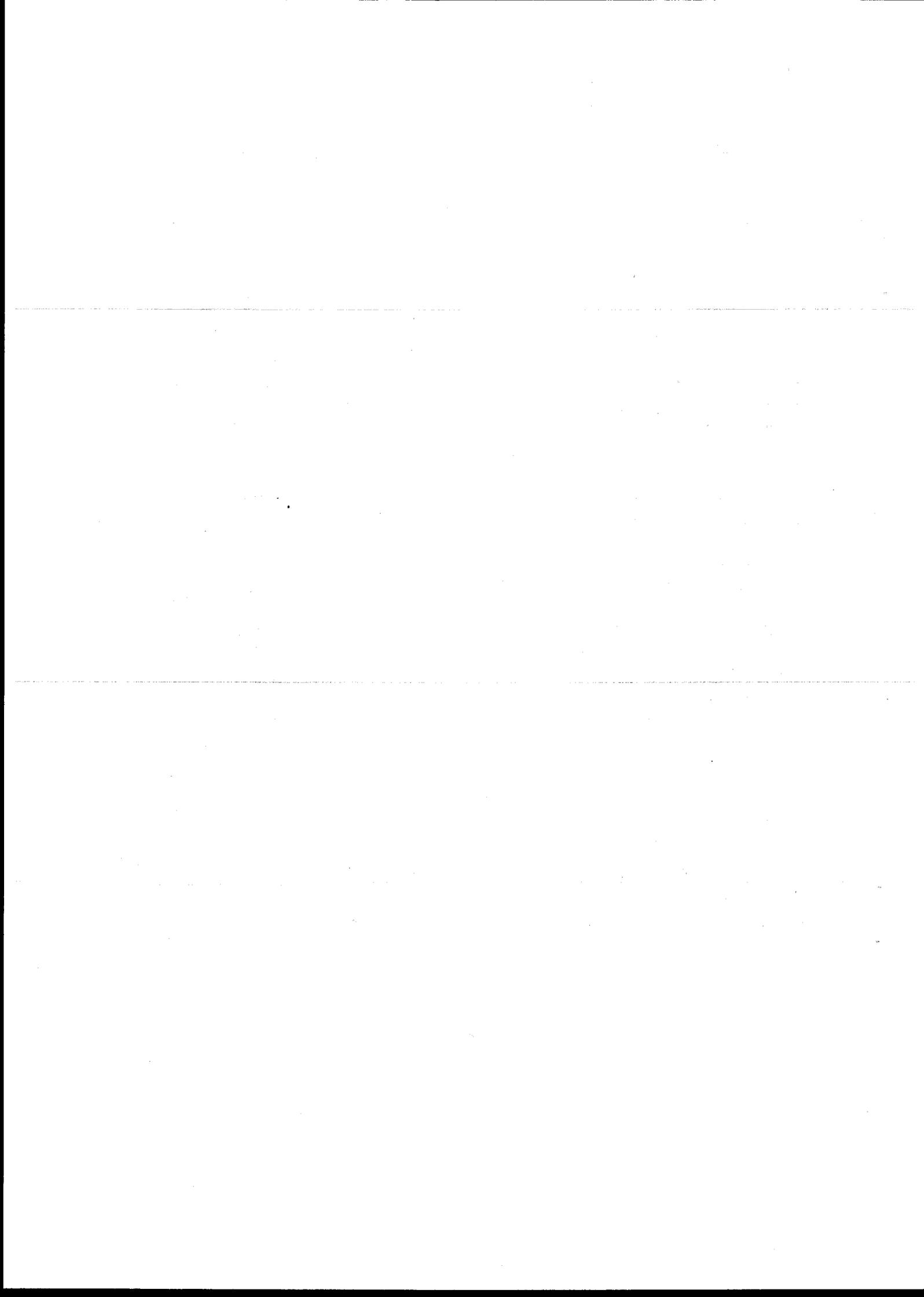
**Field Theory** - Extension field, Algebraic and transcendental extensions, Separable and inseparable extensions, Normal extension, Perfect fields, Finite fields, Primitive element, algebraically closed fields, Automorphisms of extensions, Galois extensions, fundamental theorem of Galois Theory.

Noetherian and Artinian modules and rings, Hilbert basis theorem, Wedderburn – Artin theorem.

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**REFERENCES:**

1. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul: Basic Abstract Algebra (2nd Ed.), Cambridge University Press, Indian Edition, 1997
2. I. S. Luther and I. B. S. Passi, Algebra: Vol. I - Groups, Narosa Publishing House, 1996.
3. Surjeet Singh and Quazi Zameeruddin: Modern Algebra, Vikas Publishing House Pvt. Ltd., 1990.
4. N. Jacobson: Basic Algebra: Vols. I & II, Hindustan Publishing Company, 1980.
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M.Sc. MATHEMATICS

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SEMESTER-II  
PAPER-II  
REAL ANALYSIS-II

Measurable sets- Lebesgue outer measure, Lebesgue measure, Properties of measurable sets, Borel sets and their measurability characterization of measurable sets, Non measurable set

Measurable functions- Definition and properties, Simple, Step and characteristic function, Continuous function, sets of measure Zero, Sequence of functions, Egoroff's Convergence in measure, Riesz theorem.

Lebesgue Integral- Lebesgue integral of a bounded function, Comparison of Riemann integral and Lebesgue integral, Bounded Convergence Theorem, Integral of non-negative measurable function, Fatou's Lemma, Monotone convergence theorem, General Lebesgue integral, Lebesgue dominated convergence theorem.

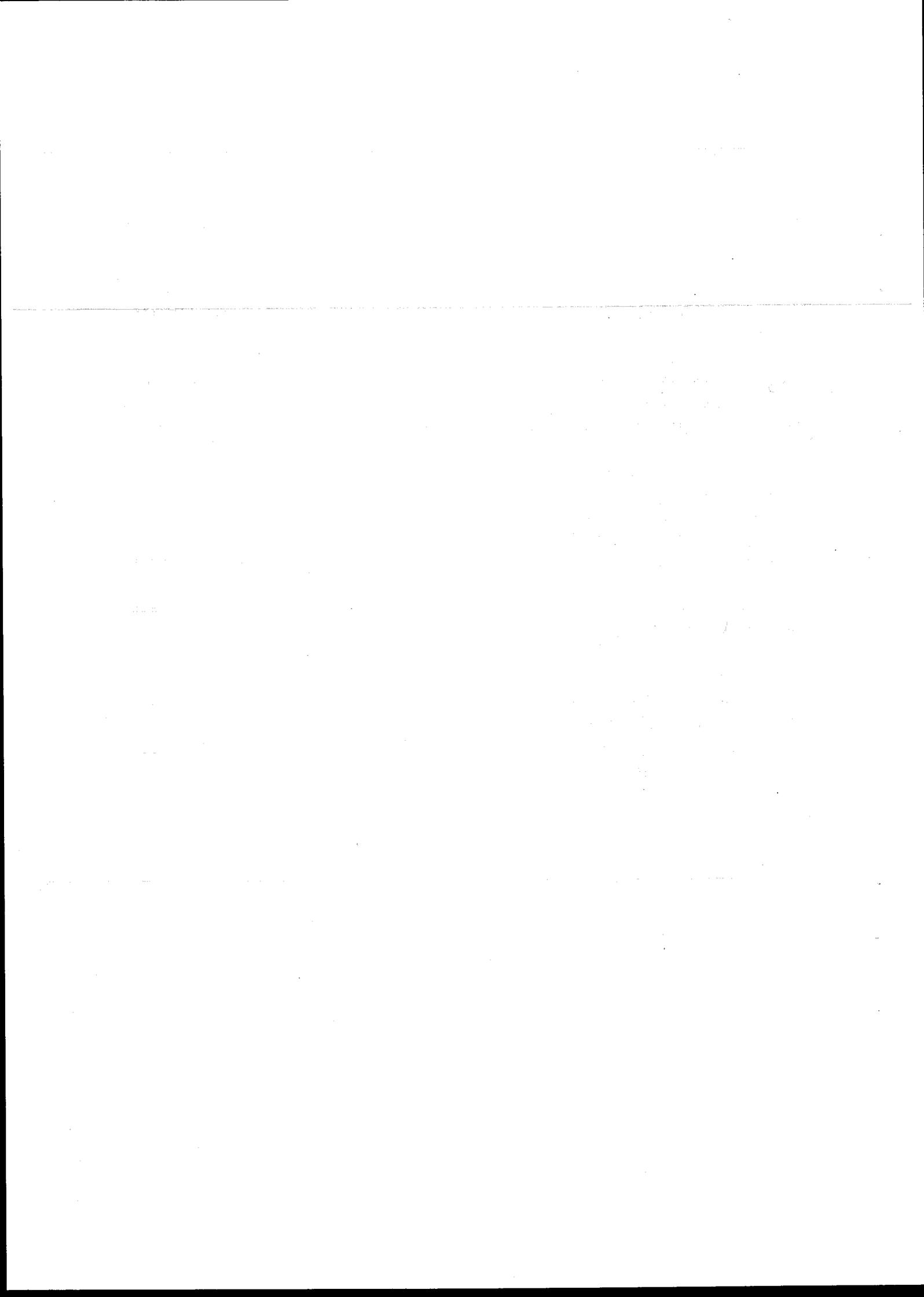
Differentiation and integration- Dini derivatives, Differentiation of monotone functions, Lebesgue theorem, Function of bounded variation, Differentiation of an integral, Lebesgue integral, Lebesgue sets, Absolutely Continuous Functions, Integral of the derivatives.

Lebesgue  $L^p$  spaces- The classes  $L^p$ , Holder and Minikowski inequalities,  $L^p$  Banach Spaces, Convergences in the mean.

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**REFERENCES:**

- [1] Walter Rudin: 'Principles of Mathematical Analysis' (3rd edition) McGraw Hill, Kogakusha, 1976, International student edition.
- [2] P.K. Jain and V.P. Gupta: 'Lebesgue Measure and Integration', New age International (P) Limited published, New Delhi 1986 (Reprint 2000).





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M.Sc. MATHEMATICS

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SEMESTER-II  
PAPER-III  
TOPOLOGY-II

Compactness - Basic properties of compactness.

Continuous functions and compact sets, compactness and Finite Intersection Property, Sequentially and Countably compact sets, Local compactness in Metric space  
Equivalence of compactness, countable compactness and sequential compactness in metric space.

Connected spaces, connectedness on the real line, Components, Locally connected spaces, totally disconnected spaces.

Nets – Topology and convergence of Nets, Hausdorffness and nets, Filters and their convergence, ultra filters.

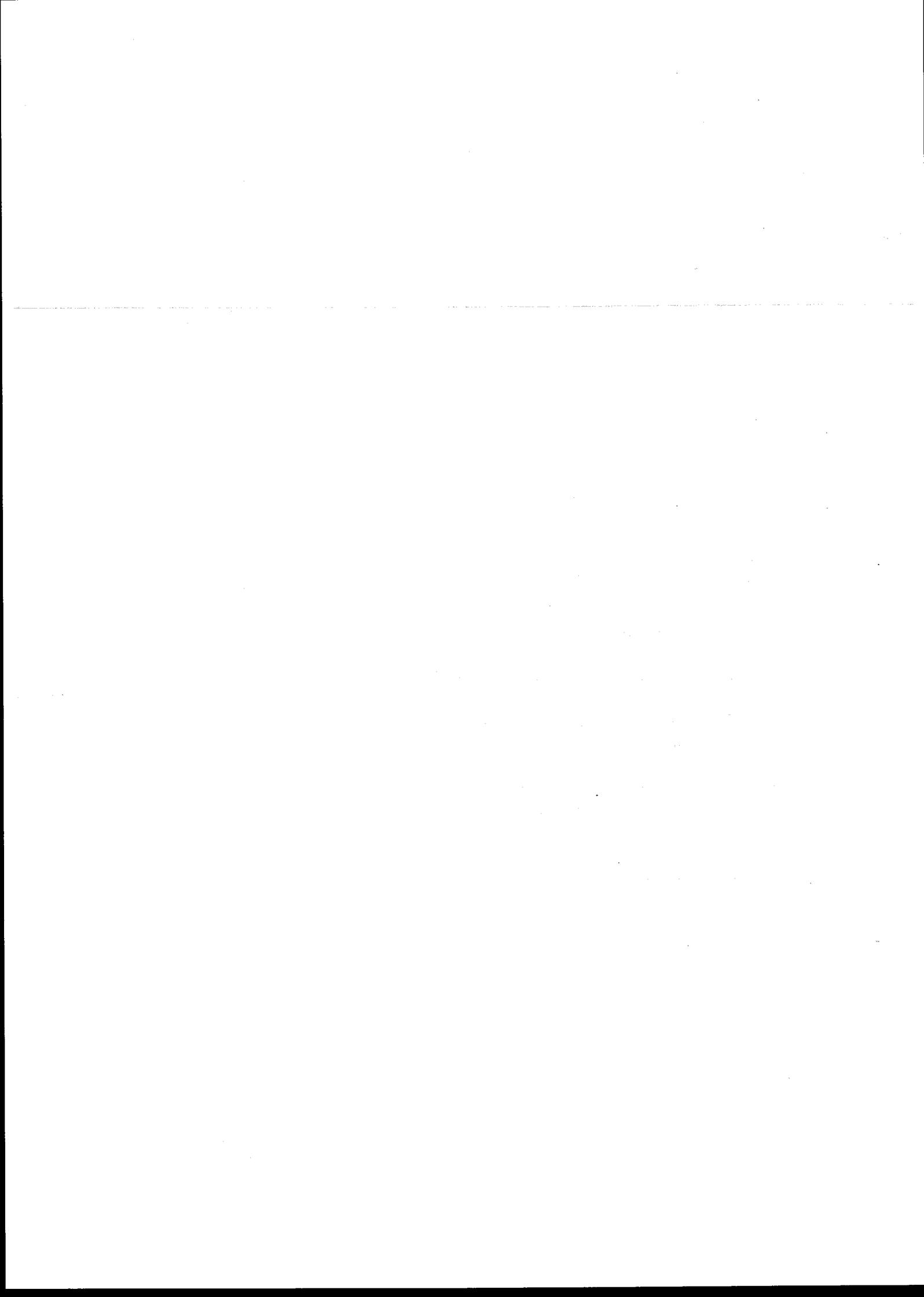
Tychonoff product topology in terms of standard sub-base and its characterization, Projection Maps.

Connectedness and product space, Compactness and product space (Tychonoff's theorem)

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**REFERENCES:**

1. G.F. Simmons :Introduction to Topology and Modern Analysis, McGraw -Hill
2. J.N .Sharma: Topology, Krishna PrakashanMandir, Meerut
3. M.J.Mansfield: Introduction to Topology. **Van Nostrand. Princeton, New Jersey, 1963**
4. Jame R. Munkres: Topology, A First Course. **Prentice Hall, Incorporated, 1974**
5. K.D.Joshi: Introduction to General Topology , New Age International(P) Ltd. New Delhi.
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SEMESTER SYLLABUS  
M.Sc. MATHEMATICS

SEMESTER-II  
PAPER-IV  
COMPLEX ANALYSIS-II

Entire Functions- Weierstress factorization theorem Gamma function and its properties, Riemann Zeta function, Riemann's functional equation, Runge's theorem, MittagLeffler's theorem.

Analytic continuation, uniqueness of direct analytic continuation, Uniqueness of analytic continuation along curve, Power series method of analytic continuation, Schwartz's Reflection Principle.

Monodromy theorem and its consequences.

Canonical product, Jensen's formula, Poisson– Jensen Formula, Hadamard's three circles theorem, Order of an entire function.

Exponent of convergence, Borel's theorem, Hadamard's factorization theorem.

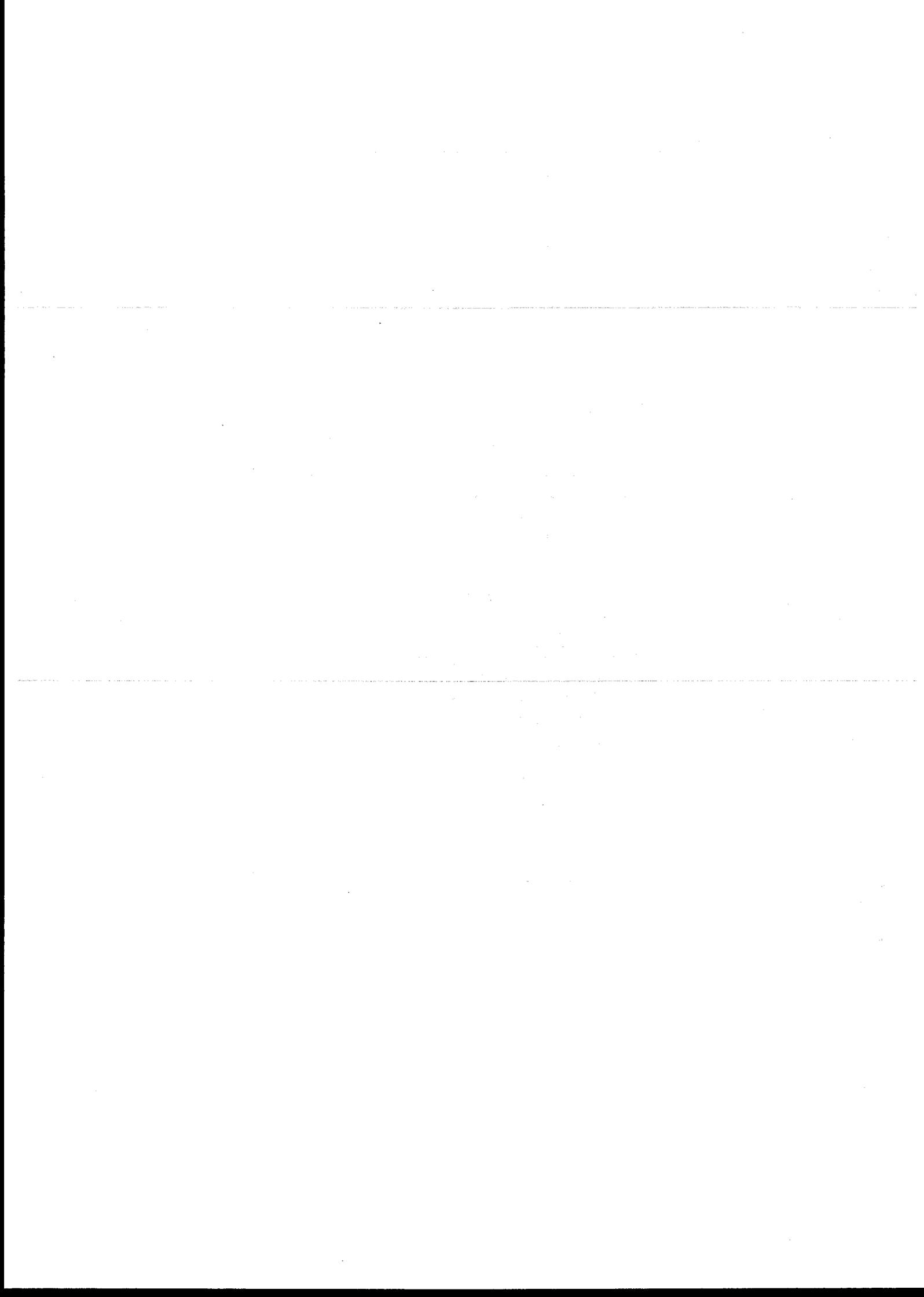
The range of an analytic function, Bloch's theorem, The little Picard theorem.

Schottky's theorem, Montel Caratheodory and the Great Picard theorem.

Univalent functions, Bieberbach's conjecture (statement only) and the "1/4 – theorem".

**REFERENCES:-**

1. J.B. Conway : Functions of one complex variable. Springer-Verlag international student Edition. Narosa publishing House. 1980.
2. D. Sarason : Complex Function theory. Hindustan Book Agency. Delhi 1994.
3. S. Ponnusamy : Foundation of complex Analysis. Narosa publishing house 1997.
4. J.N. Sharma.: Functions of a complex variable, Krishna Prakashan Mandir, Meerut
5. B.S. Tyagi: Functions of a Complex Variable, Kedar Nath Ram Nath Prakashan, Meerut, 1981.





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M.Sc. MATHEMATICS

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SEMESTER-II  
PAPER-V  
ADVANCE DISCRETE MATHEMATICS-II

**Grammar and Language-** Phase structure grammar, Rewriting Rules, Derivation, sentential forms, context-sensitive context, Free and Regular grammars and language, Notion of syntax, Analysis, Polish Notation, Conversion of Infix expression to Polish Notation, The Rename Polish Notation.

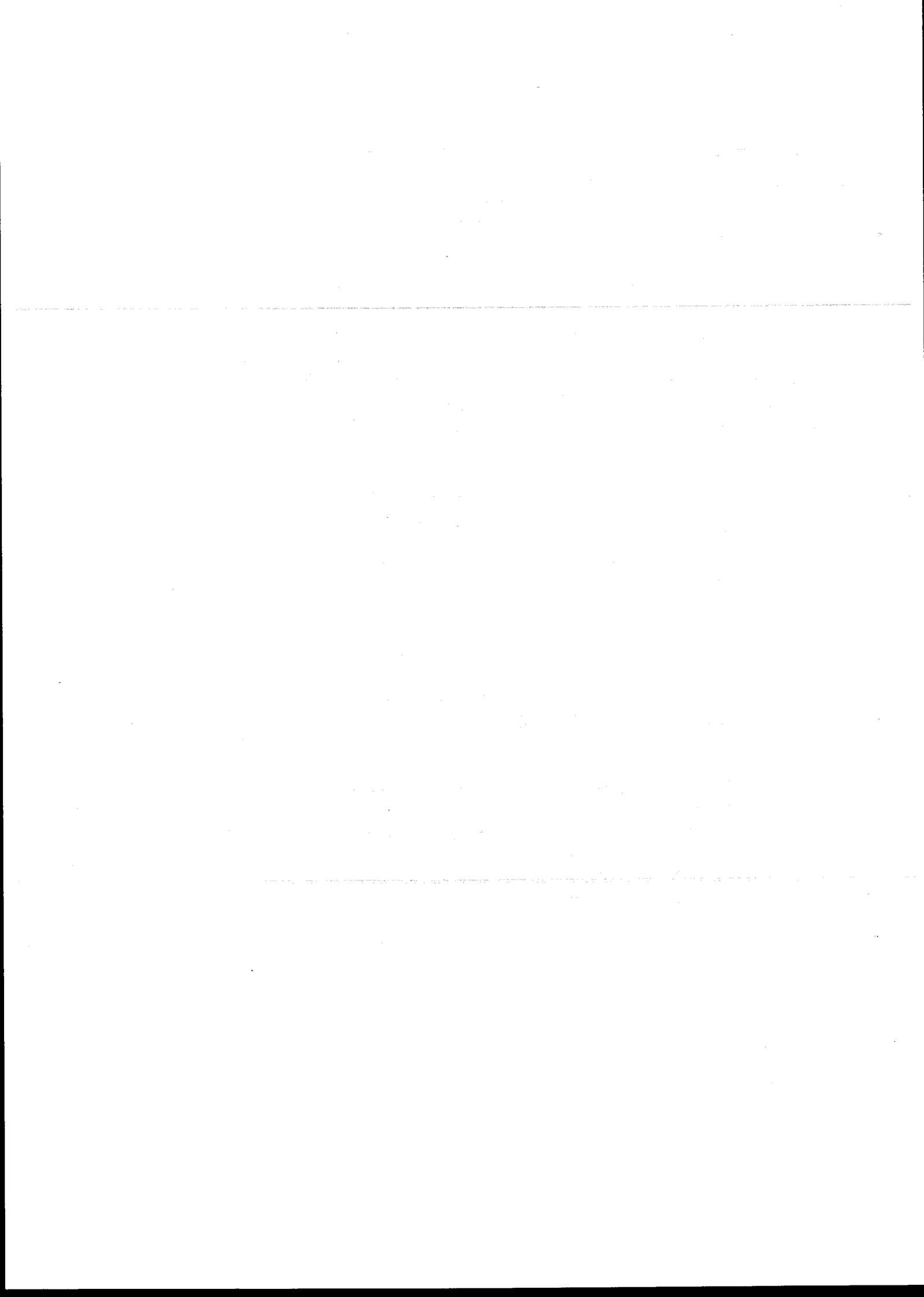
**Introductory Computability Theory-** Finite state Machines and their Transition, Table diagrams, Equivalence of Finite state Machines, reduced machines, Homomorphism Finite automata, and equivalence of its power to that of Deterministic finite automata, Moore and Mealy Machines, Turing machines and partial recursive functions.

**Graph Theory-** Definition of (undirected) graph, paths, Circuits Cycles & Sub graphs, Induced Sub graphs, Degree of a vertex, Connectivity, Planar Graphs and their properties, Trees, Euler's Formula for connected planar Graphs. Complete and complete Bipartite graphs, Kuratowski's Theorem(statement only), and its use, Spanning trees. Cut sets. Fundamental cut sets and cycles, Minimal spanning trees. Matrix representation of graphs, Euler's theorem on the Existence of Eulerian Paths, and circuit, Directed Graphs, In degree and out degree of a vertex, Weighted undirected Graphs.

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**REFERENCES:**

1. J.P. Tremblay & R. Manohar: Discrete Mathematical structure with application to computer sciences. McGraw Hill Book Co. 1997.
2. Seymour Lipschutz.: Finite Mathematics (International edition 1993) McGraw Hill Book Co. New York.
3. N. Deo: Graph Theory with applications to Engineering and Computer Sciences. Prentice Hall of India.
4. S. Wiitala: Discrete Mathematics - A unified approach McGraw Hill Book Co. New York.
5. C.L. Liu: Elements of Discrete mathematics. McGraw Hill Book Co.
6. M.K.Gupta: Discrete Mathematics , Krishna PrakashanMandir(P) Ltd., Meerut.





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M.Sc. MATHEMATICS

SEMESTER-III  
PAPER-I (COMPULSORY)  
INTEGRATION THEORY AND FUNCTIONAL ANALYSIS-I

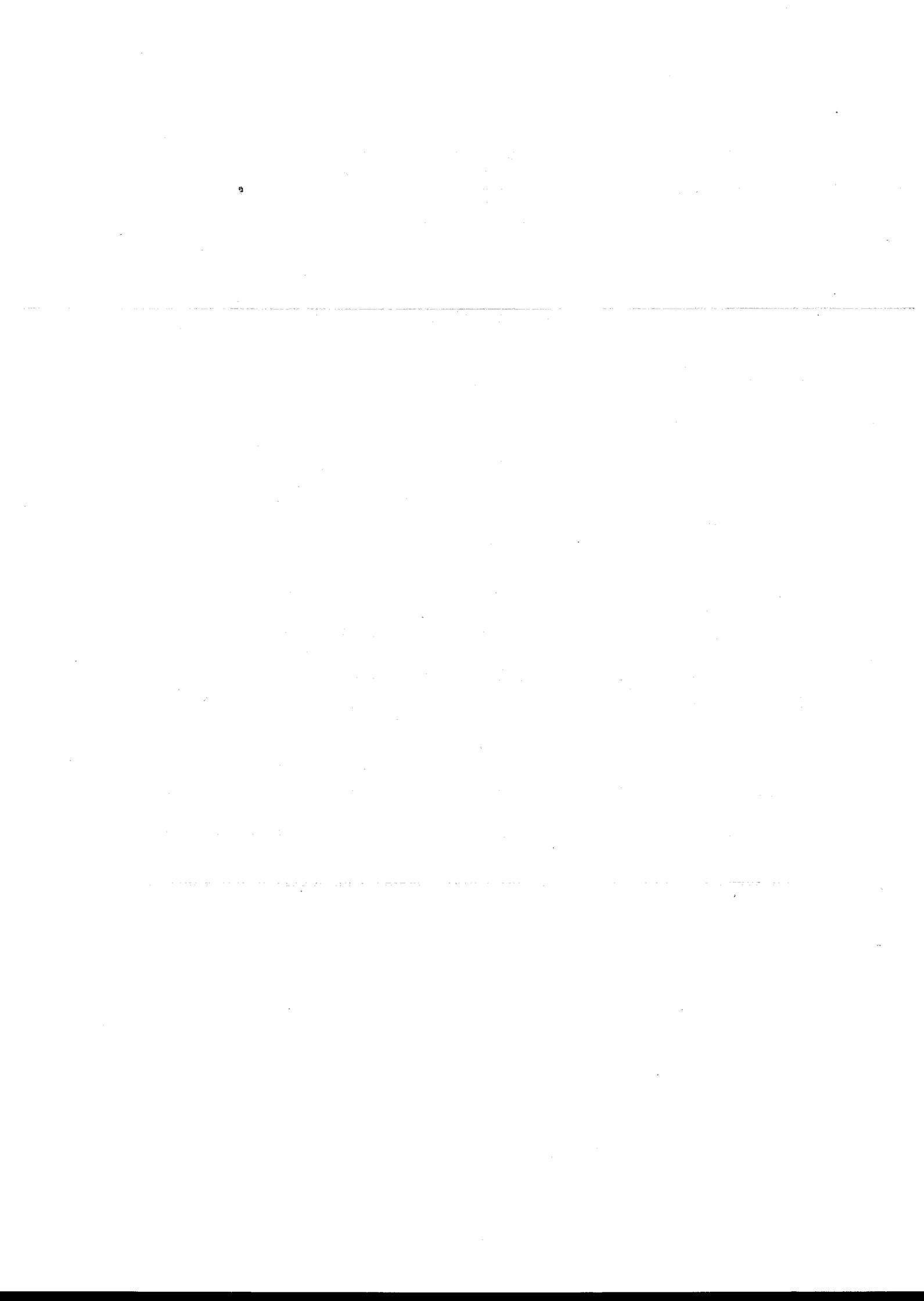
Signed measure, Hahn decomposition theorem, mutually singular measures, Radon-Nikodym theorem, Lebesgue decomposition, Riesz representation theorem, Extension theorem (Caratheodory)

Lebesgue-Stieltjes integral, product measures, Fubini's theorem, Tonelli's theorem, Integral operator, Inner measure, Extension by set of measure zero, Caratheodory outer measure. Hausdorff measure, Differentiation and Integration, Decomposition into absolutely continuous and singular parts.

Baire sets, Baire measure, continuous functions with compact support, Regularity of measures on locally compact spaces.

**REFERENCES:**

1. H.L. Royden: Real Analysis, Macmillan Publishing Co. Inc., New York, 4th Edition, 1993.
2. B.Choudhary and Sudarsan Nanda: Functional Analysis with Applications Wiley Eastern Ltd., 1989
3. J.H. Williamson: Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962
4. P.R. Halmos: Measure Theory, Van Nostrand, Princeton, 1950.
5. T.G. Hawkins: Lebesgue's Theory of Integration: Its Origins and Development, Chelsea, New York, 1979.
6. B.V. Limaye: Functional Analysis, Wiley Eastern Ltd.
7. G.de. Barra: Measure Theory & Integration, Wiley Eastern Ltd, 1981.
8. Walter Rudin: Real & Complex Analysis, Tata McGraw Hill Publishing. Company, New Delhi.
9. P.K.Jain, O.P.Ahuja & Khalid Ahmad: Functional Analysis, New Age International (P)Ltd., New Delhi.
10. A.Siddiqui: Functional Analysis with Applications: Tata McGraw Hill Publishing Company, New Delhi.





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SEMESTER-III  
PAPER- II (Compulsory)  
Partial Differential Equations, Mechanics & Gravitation-I

Partial Differential Equations

**Laplace's Equation**—Fundamental solution, Mean value formulae, Properties of Harmonic function, Green function, Energy method.

**Heat Equation** - Fundamental solution, Mean value formulae, Properties of solution, Energy method.

**Wave Equation** - Solutions by spherical means, Homogeneous equations, Energy method.

Non-linear first order PDE, complete integrals, Envelopes characteristics, Hamilton Jacobi equations (calculus of variations, Hamilton's ODE), Conservation Laws, Representation of solutions, Separation of variables.

Laplace and Fourier Transforms and their applications, Legendre Transform.

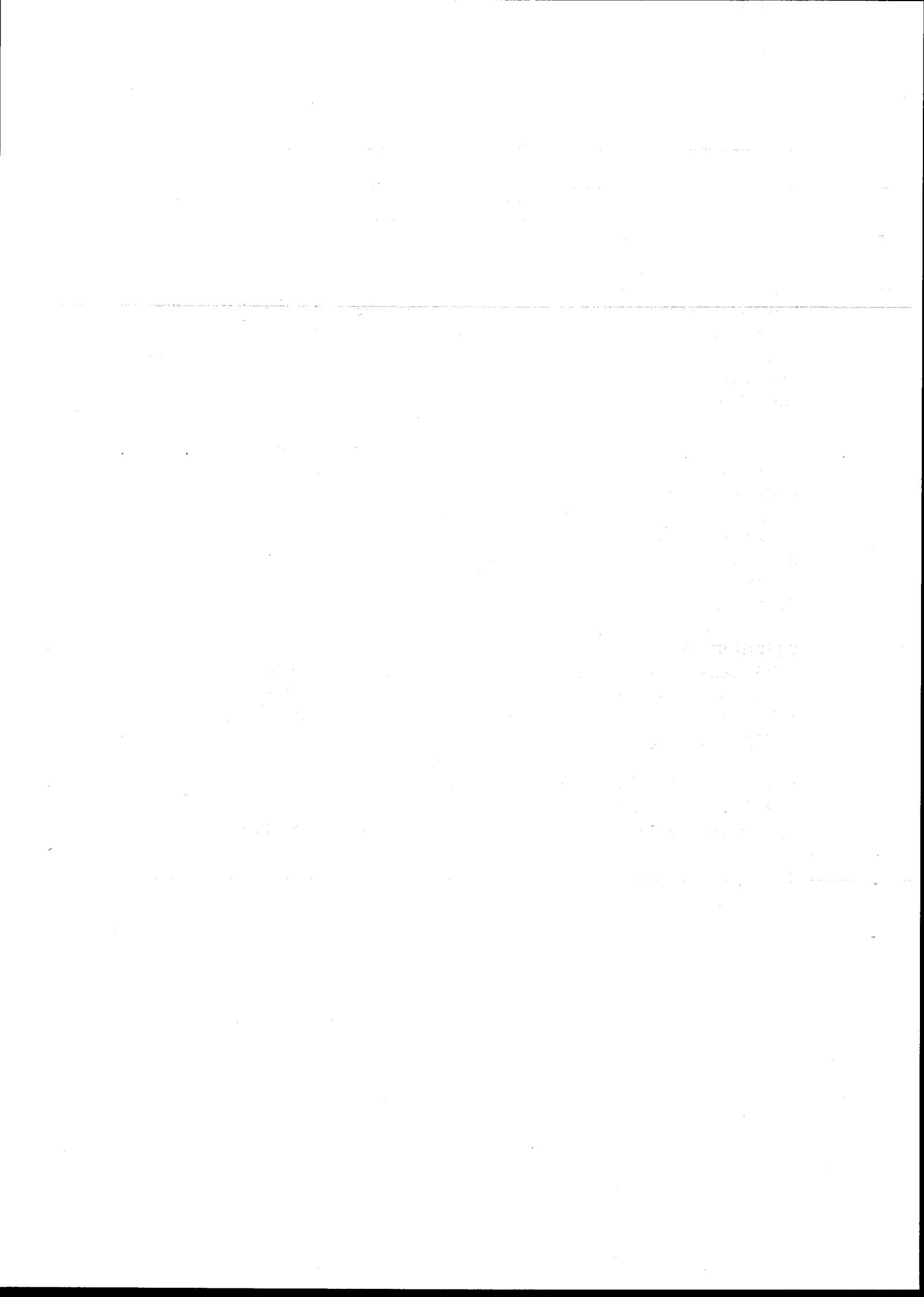
**Attraction** - Attraction of rod, disc, spherical shell and sphere, spherical shell of finite thickness.

Surface integral of normal attraction (Application & Gauss's theorem) Laplace and Poisson equations, work done by self-attracting system.

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**REFERENCES:**

1. D.Raisinghania: Ordinary and Partial Differential Equation, S.Chand , New Delhi.
2. Gupta, Kumar & Sharma: Classical - Mechanics, Pragati Prakashan,
3. S.L. Loney :An Elementary Treatise On Statics,University Press.
4. I.N. Sneddon: Partial Differential Equation , McGraw Hill Book Co.Ltd.
5. H.Goldstem: Classical Mechanics, Addition Wesley.
6. Narayan Chandra Rana&PramodSharad, Chandra Joag: Classical Mechanics. Tata McGraw-Hill Publishing Company, 1991.
7. B.D. Gupta &SatyaPrakash: Mechanics Relativity .PragatiPrakshan, Meerut.





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SEMESTER-III  
PAPER-III (OPTIONAL)  
PROGRAMMING IN C (WITH ANSI FEATURES)-I

An overview of programming, Programming language, Classification- C Essentials Program Development Functions, Anatomy of a C Function, Variables and Constants, Expressions, Assignment Statements, Formatting Source Files, Continuation Character, The Pre-processor.

Scalar Data Types– Declarations, Different Types of Integers, Different kinds of Integer Constants, Floating- Point Types, Initialization, Mixing Types, Explicit Conversions- Casts, Enumeration Types, The Void Data Type, Typedefs, Finding the Address of an object Pointers.

Control Flow– Conditional Branching, The Switch Statement, Looping, Nested Loops, The break and continue Statements, The go to statement. Infinite Loops.

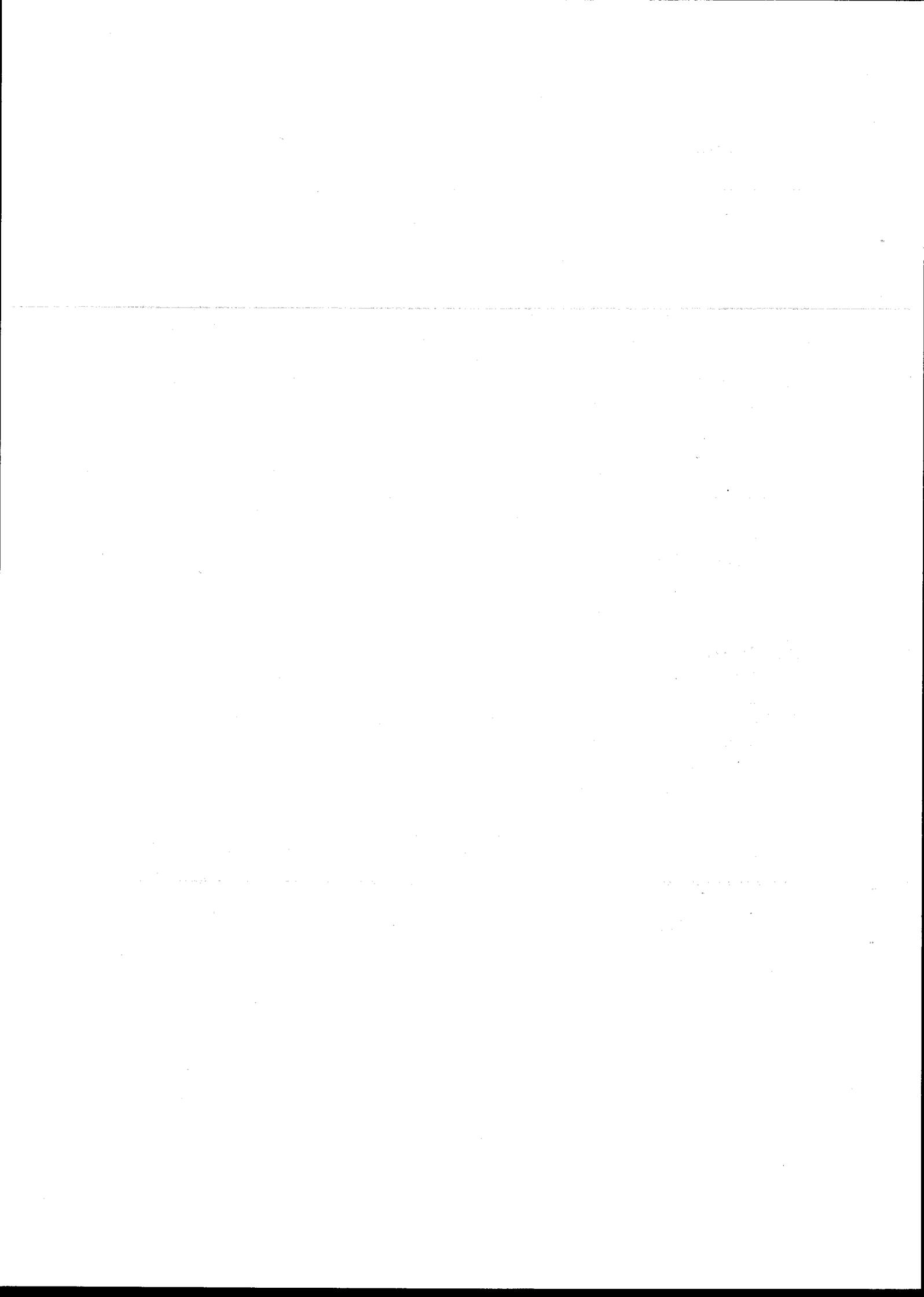
Operators and Expressions–Precedence and Associativity, Unary Plus and Minus operators, Binary arithmetic operators, Arithmetic assignment operators, Increment and Decrement Operators, Comma Operator, Relational Operators, Logical Operators, Bit-Manipulation Operators, Bitwise Assignment Operators, Cast Operator, Size of Operators, Conditional Operator, Memory Operators.

**REFERENCES:**

1. Peter A. Darnell and Philip E. Margolis, C: A Software Engineering Approach, Narosa Publishing House (Springer International Student Edition) 1993.
2. Brian W. Kernighan & Dennis M. Ritchie: The C Programme Language, 2<sup>nd</sup> Edition (ANSI Features), Prentice Hall 1989.
3. Yashwant Kanetkar: Let Us C, 8th Edition, B P B Publications 2007.
4. E. Balagurusamy: Programming in C (ANSI), 4th Edition, Tata Mac Graw Hill.

**PRACTICAL**

The break-up of marks for third Semester's Practical will be as under:			
Sr. No.	Argument	Maximum Marks	Minimum Passing Marks
1.	Lab Record (Internal Assessment)	6	
2.	Viva-voce (External Assessment)	9	
3.	Program Development and Execution (External Assessment)	15	
Total Marks		30	11





बिलासपुर विश्वविद्यालय, बिलासपुर (छत्तीसगढ़)  
SEMESTER SYLLABUS  
M.Sc. MATHEMATICS

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SEMESTER-III  
PAPER-IV (OPTIONAL)  
FUZZY SETS AND THEIR APPLICATIONS-I

Fuzzy sets- Basic definitions  $\alpha$  – cuts, Convex fuzzy sets, Basic operations on fuzzy sets, Types of fuzzy sets, properties of  $\alpha$  – cuts, representation of fuzzy sets, First and Second decomposition theorem, Extension Principle for fuzzy sets, fuzzy complements, the two characterization theorems on fuzzy complementst-norms and t-conorms, Algebraic product and sum, bounded difference and sum, statements of characterization for t-norms and t-conorms, combination of operators.

Fuzzy Arithmetic- Fuzzy numbers, Arithmetic operations on fuzzy numbers, Lattices of fuzzy numbers, fuzzy equations.

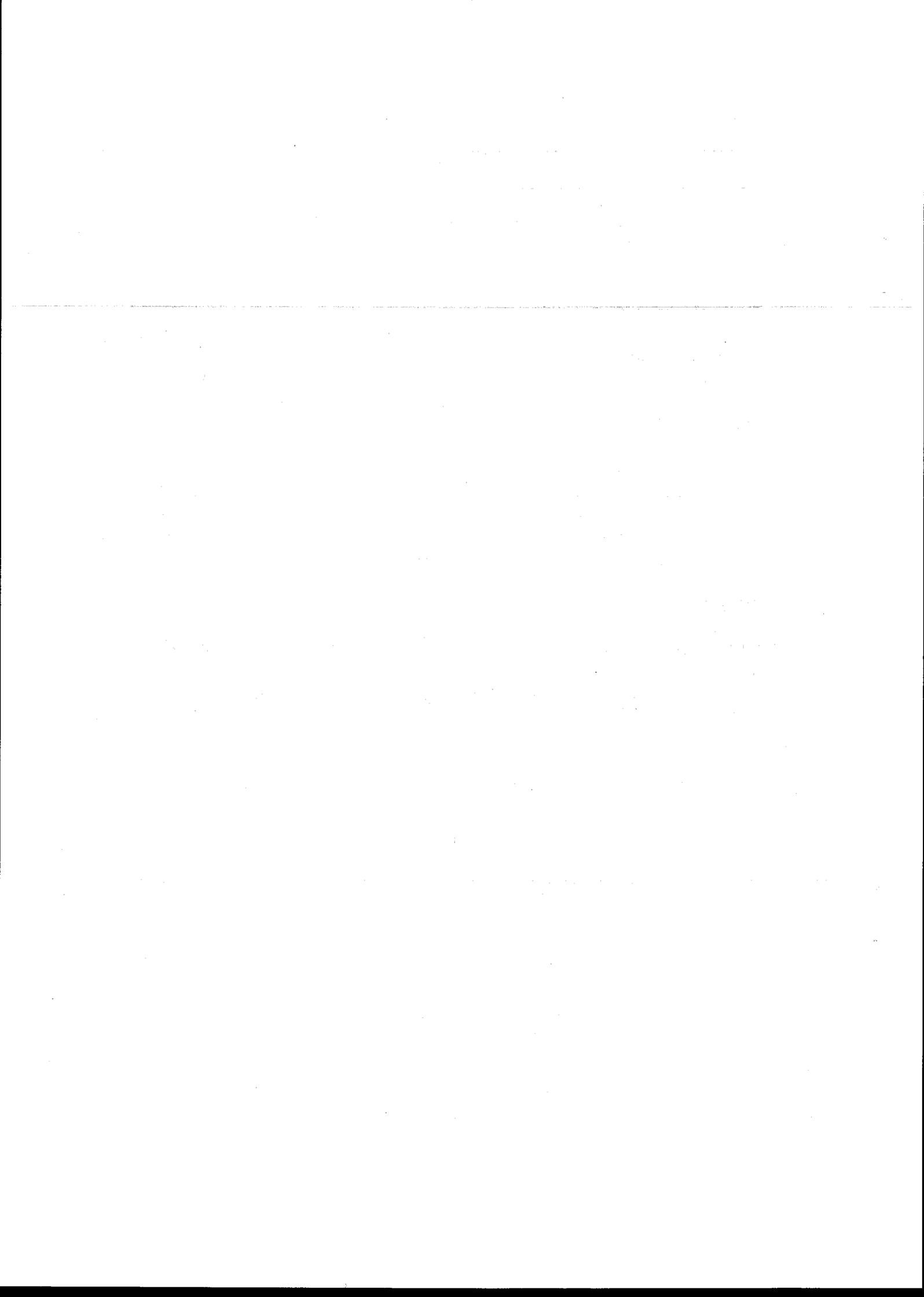
Fuzzy Relations- Fuzzy relations on fuzzy sets, fuzzy binary relations and fuzzy equivalence relations, Fuzzy morphism, standard composition, sup i composition, inf-wi composition of fuzzy relations.

Fuzzy Relations Equations- Problem partitioning, solution methods, fuzzy relation equations based upon sup i composition and inf-wi composition, approximate solution.

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**REFERENCES:**

1. G.J. Klir and B. Yuan: Fuzzy Sets and Fuzzy logic, Prentice Hall of India New Delhi
2. H.J. Zimmermann: Fuzzy Sets and Fuzzy logic, Prentice Hall of India New Delhi





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SEMESTER SYLLABUS  
M.Sc. MATHEMATICS

SEMESTER-III  
PAPER-V (OPTIONAL)  
OPERATIONS RESEARCH-I

Operations Research and its Scope, Necessity of Operations Research in Industry, Linear Programming-graphical method of solutions, Simplex Method, Theory of the Simplex Method, Two phase method, Big M method of solution to LPP, Duality in linear programming, Duality theorems, Dual Simplex method, Other Algorithms for Linear Programming-Dual Simplex Method.

Parametric Linear Programming, Upper Bound Technique, Interior Point Algorithm, Linear Goal Programming, Assignment Problems, Its mathematical formulation, Solution of assignment problems, Optimality test. Transportation Problems, Formulation of transportation problems, Solutions of Transportation problems, North-West corner method, least cost method, Vogel's approximation method, Test for optimality U-V method.

Network Analysis—shortest Path Problem, Minimum Spanning Tree Problem, Maximum Flow Problem, Minimum Cost Flow Problem, Network simplex Method. Project Planning and Control I with PERT CPM.

**REFERENCES:**

1. F.S. Hillier and G.J. Ueberman: Introduction to Operations Research (Sixth Edition), McGraw Hill International Edition, Industrial Engineering Series, 1995 Affiliated East-West Press Pvt. Ltd., New Delhi, Madras.
2. G. Hadley: Linear Programming, Narosa Publishing House, 1995.
3. G. Hadly, Nonlinear and Dynamic Programming, Addison-Wesley, Reading Mass.
4. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali: Linear Programming and Network flows, John Wiley & Sons, New York, 1990.
5. H.A. Taha: Operations Research—An introduction, Macmillan Publishing Co., Inc., New York.
6. K. Swarup, P.K. Gupta and M. Mohan: Operations Research, Sultan Chand & Sons, N.Delhi.
7. S.S. Rao: Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.
8. P. K. Gupta and D.S. Hira, : Operations Research, S. Chand & Co. Ltd., New Delhi.
9. N.S. Kambo, Mathematical Programming Techniques, Affiliated East-West Press Pvt. Ltd., New Delhi, Madras.
10. S.D.Sharma: Operations Research, KedarNath Ram Nath Publication, Meerut.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. This ensures transparency and allows for easy verification of the data. The text also mentions that regular audits are necessary to identify any discrepancies or errors in the accounting process.

2. The second part of the document focuses on the classification of expenses. It provides a detailed list of categories, such as salaries, rent, utilities, and travel. Each category is further broken down into sub-categories to ensure that every expense is properly recorded. The document also includes guidelines on how to handle mixed-use expenses, such as a car used for both business and personal purposes. It suggests using a mileage log to track business-related travel.

3. The third part of the document discusses the importance of staying up-to-date with tax laws and regulations. It notes that tax rules can change frequently, and it is crucial for businesses to consult with a tax professional to ensure compliance. The text also mentions that businesses should take advantage of all available tax deductions and credits to reduce their tax liability. It provides a list of common deductions, such as the Section 179 deduction for equipment and the Research and Development credit.

4. The final part of the document provides a summary of the key points discussed. It reiterates the importance of accurate record-keeping, proper classification of expenses, and staying informed about tax changes. The document concludes by encouraging businesses to seek professional advice when needed to ensure that their financial records are accurate and that they are maximizing their tax savings. It also includes a disclaimer stating that the information provided is for general informational purposes only and should not be considered as tax advice.



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SEMESTER SYLLABUS  
M.Sc. MATHEMATICS

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SEMESTER-III  
PAPER-VI (OPTIONAL)  
FLUID MECHANICS-I

Kinematics- Lagrangian and Eulerian Methods, Equation of continuity, Stream lines, path lines, streak lines, velocity potential, Irrotational and rotational motions, Boundary surfaces, Vortex lines.

Equations of motion-Euler's dynamical Equations, Bernoulli's Equation of motion by flux method, Equations of motion under Impulsive forces, Principle of Energy for Incompressible fluids, Lagrange's Equations.

Motion in Two dimensions-Lagrange's stream function, Irrotational motion in two dimensions, Complex velocity Potential, sources, sinks, doublets and their Images, Use of conformal Transformation. The Milne-Thomson Circle Theorem of Blasius.

Motion of Cylinders- Motion of a general, circular and coaxial cylinders, Circulation about a moving cylinder, Streaming and circulation about a fixed circular cylinder.

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**REFERENCES:**

1. A.S.Ramsey: A treatise on Hydrodynamics Part II, CBS Publication, Delhi
2. F.Choriton: Text book of Fluid Mechanics, CBS Publication, Delhi
3. L.D.Landan & E.M.Lipschitz: Fluid Mechanics, Pergaman Press.
4. R.K.Rathy: An Introduction to Fluid Dynamics, Oxford and IBH Company, New Delhi, 1976.





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M.Sc. MATHEMATICS

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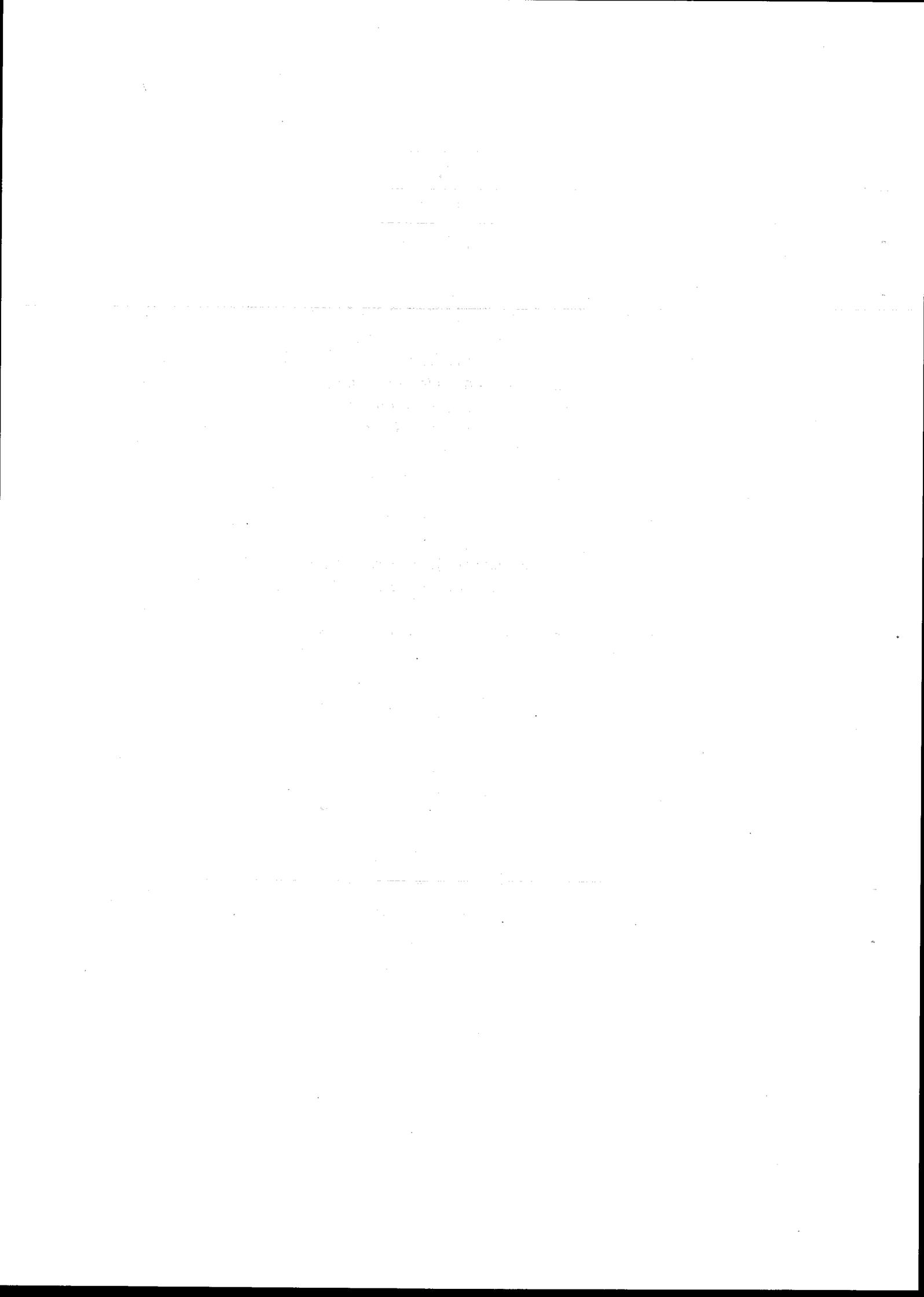
SEMESTER-III  
PAPER- VII (OPTIONAL)  
INFORMATION THEORY- I

Measure of Information –Axioms for a measure of uncertainty, The Shannon entropy and its properties, Joint and conditional entropies, Transformation and its properties, Some Intuitive properties of a measure of entropy–Symmetry, normalization, expansibility, boundedness, recursivity, maximality, stability, additivity, subadditivity, nonnegativity, continuity, branching etc and interconnection among them, Axiomatic characterization of the Shannon entropy due to Tverberg and Leo. Information functions, the fundamental equation of Information, information function continuous at the origin, nonnegative bounded information functions, measurable information functions and entropy, The fundamental theorem of Information Theory and its strong and weak converses.

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**REFERENCES:**

1. R.ASH: Information Theory , Inter science Publishers, New York, 1965.
2. F.M.REZA: An Introduction to Information Theory, McGraw Hill Book Company, Inc., 1961
3. J,Aczel and Z.Daroczy: On Measures of Information and their characterization, Academic Press, New York.





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SEMESTER SYLLABUS  
M.Sc. MATHEMATICS

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SEMESTER-III  
PAPER-VIII (OPTIONAL)  
FUNDAMENTALS OF COMPUTER SCIENCE-I

Object Oriented Programming – Classes and Scope, Nested Classes, Pointer, Class Members, Class Initialization, Assignment and Destruction, Overload functions and Operators, Templates including class templates, Class inheritance and sub-typing, multiple and virtual Inheritance.

Data Structures -Analysis of Algorithms, q, W,o,w notations; Lists, Stacks, and Queues. Sequential and linked representations, Trees: Binary tree – Search Tree Implementation, B-tree (concept only) Hashing–open and closed; Sorting Insertion sort, shell sort, quick sort, beap sort and their analysis.

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**REFERENCE:**

1. S.B.Lipman, J.Lajoi: C++ Primer, Addison Wesley.
2. B.Stroustrup: The C++ Programming Language, Addison Wesley.
3. C.J.Date: Introduction to Database System, Addison Wesley.





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SEMESTER SYLLABUS  
M.Sc. MATHEMATICS

SEMESTER-IV  
PAPER-I (COMPULSORY)  
INTEGRATION THEORY AND FUNCTIONAL ANALYSIS-II

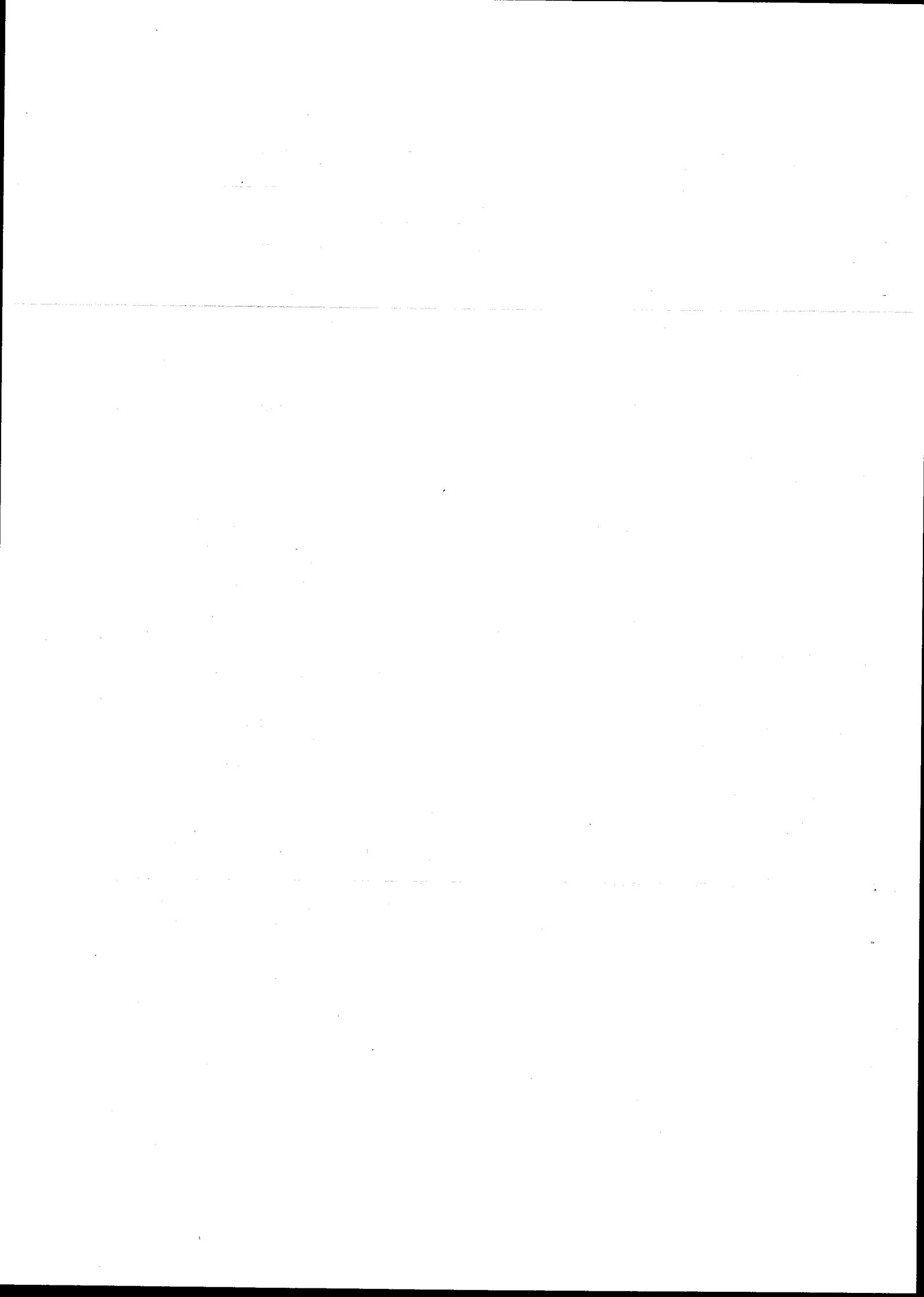
Normed linear spaces, Banach space and examples, Quotient space of normed linear spaces and its completeness, equivalent norms, Riesz Lemma, basic properties of finite dimensional normed linear spaces and compactness, Weak convergence and bounded linear transformations, normed linear spaces of bounded transformations, dual spaces with examples.

Uniform boundedness theorem and some of its consequences, Open mapping and closed graph theorems, Hahn-Banach theorem for real linear spaces, complex linear spaces and normed linear spaces, Reflexive spaces, Weak Sequential Compactness, Compact Operators, Solvability of linear equations in Banach spaces (Fredholm alternatives) The closed Range Theorem.

Inner product spaces, Hilbert spaces, Ortho-normal Sets, Bessel's inequality, Complete Ortho-normal sets and Parseval's identity, structure of Hilbert spaces, Projection theorem. Riesz representation theorem, Adjoint of an operator on a Hilbert space, Reflexivity of Hilbert spaces, Self adjoint operators, Positive, Projection, normal and unitary operators.

**REFERENCES:**

1. H.L. Royden: Real Analysis, Macmillan Publishing Co. Inc., New York, 4th Edition, 1993.
2. B.Choudhary and Sudarsan Nanda: Functional Analysis with Applications Wiley Eastern Ltd., 1989
3. J.H. Williamson: Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962
4. P.R. Halmos: Measure Theory, Van Nostrand, Princeton, 1950.
5. T.G. Hawkins: Lebesgue's Theory of Integration: Its Origins and Development, Chelsea, New York, 1979.
6. B.V.Limaye: Functional Analysis, Wiley Eastern Ltd.
7. G.de. Barra: Measure Theory & Integration, Wiley Eastern Ltd, 1981.
8. Walter Rudin: Real & Complex Analysis, Tata McGraw Hill Publishing. Company, New Delhi.
9. P.K.Jain ,O.P.Ahuja& Khalid Ahmad: Functional Analysis, New Age International (P)Ltd., New Delhi.
- 10.A.Siddiqui: Functional Analysis with Applications: Tata McGraw Hill Publishing Company, New Delhi.





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SEMESTER SYLLABUS  
M.Sc. MATHEMATICS

SEMESTER-IV  
PAPER-II (COMPULSORY)  
PARTIAL DIFFERENTIAL EQUATIONS, MECHANICS & GRAVITATION-II

Generalised co-ordinates, Holonomic and non-holonomic systems, Scleronic and Rheonomic system, Generalised Potentials.

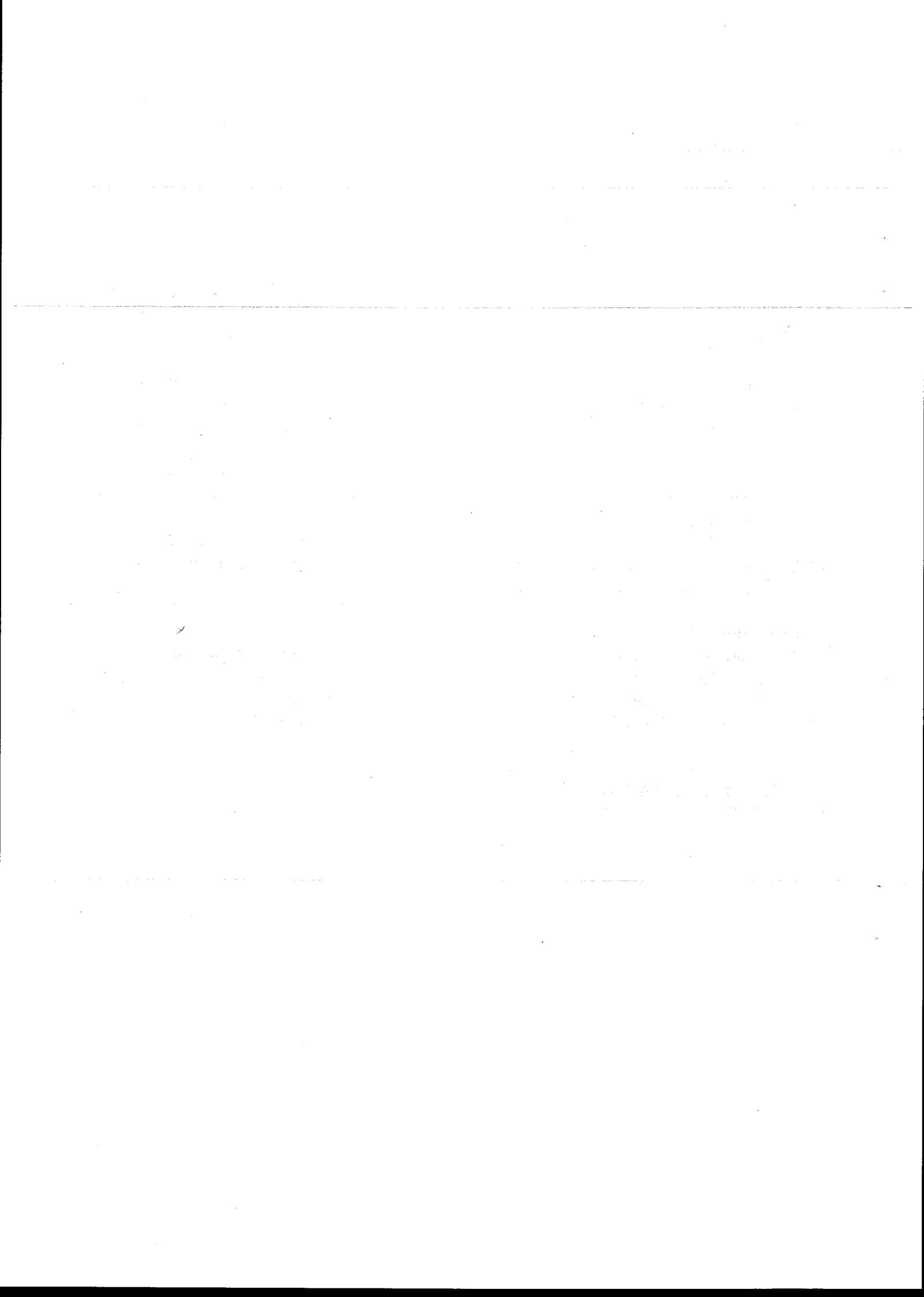
Lagrange's equations of first kind, Lagrange's equations of second kind, Uniqueness of solution, Energy equation for conservation fields

Hamilton's variable, Hamilton canonical equations, cyclic coordinates, Routh's equations. Poisson's Bracket, Poisson's Identity, Jacobi-Poisson Theorem, Lagrange's Bracket, Motivating problems of calculus of variations, Shortest distance, Minimum surface of revolution, Brachistochrone problem, Isoperimetric problem, Geodesic, Fundamental lemma of calculus of variations, Euler's equation for one dependent function and its generalization to (i) independent functions, (ii) higher order derivatives, Conditional extremum under geometric constraints and under integral constraints.

Potential of rod, disc, spherical shell and sphere, spherical shell of finite thickness, Distributions for a given potential, Equipotential surfaces, Surface and solid harmonics. Surface density in terms of surface harmonics.

**REFERENCES :**

1. D. Raisinghania : Ordinary and Partial Differential Equation, S.Chand , New Delhi.
2. Gupta ,Kumar & Sharma: Classical - Mechanics, **PragatiPrakashan**,
3. S.L. Loney :An Elementary Treatise On Statics, University Press.
4. I.N. Sneddon: Partial Differential Equation , McGraw Hill Book Co.Ltd.
5. H.Goldstem: Classical Mechanics, Addition Wesley.
6. Narayan Chandra Rana & Pramod Sharad, Chandra Joag: Classical Mechanics. **Tata McGraw-Hill Publishing Company, 1991.**
7. B.D. Gupta & Satya Prakash: Mechanics Relativity .PragatiPrakashan, Meerut.





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SEMESTER SYLLABUS  
M.Sc. MATHEMATICS

SEMESTER-IV  
PAPER- III (OPTIONAL)  
PROGRAMMING IN C (WITH ANSI FEATURES)-II

Arrays–Declaring an Array, Array and Memory, Initializing Arrays, Encryption and Decryption

Storage Classes– Fixed vs. Automatic Duration, Scope, Global variables, The Register Specifier, ANSI rules for the syntax and Semantics of the storage – class keywords.

Pointers– Pointer Arithmetic, Passing Pointer as Function Arguments, Accessing Array Elements through Pointers, Passing Arrays as Function Arguments, Sorting Algorithms, Strings, Multidimensional Arrays, Arrays of Pointers, Pointers to Pointers.

Functions–Passing Arguments, Declarations and Calls, Pointers to Functions, Recursion, The main Function, Complex Declarations, The C Preprocessor–Macro Substitution, Conditional Compilation, Include Facility, Line Control.

Structures and Unions– Structures, Dynamic Memory Allocation, Linked Lists, Unions, enum Declarations

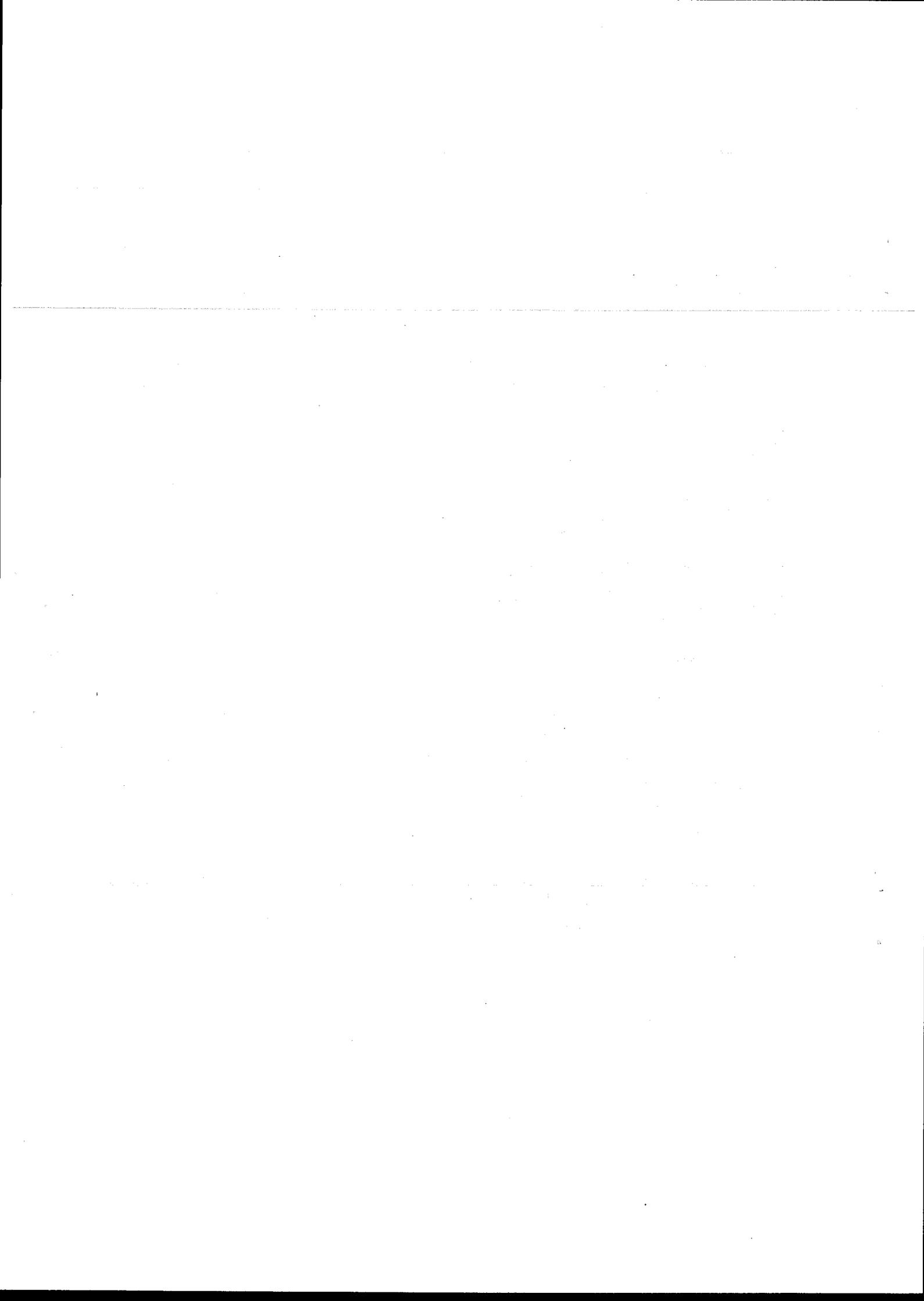
Input and Output– Streams, Buffering, The <Stdio.h> Header File, Error Handling, Opening and Closing a File, Reading and Writing Data, Selecting an I/O Method, Un-buffered I/O Random Access, The standard library for Input/ Output.

**REFERENCES:**

1. Peter A. Darnell and Philip E. Margolis, C: A Software Engineering Approach, Narosa Publishing House (Springer International Student Edition) 1993.
2. Brian W. Kernighan & Dennis M. Ritchie: The C Programme Language, 2<sup>nd</sup> Edition (ANSI Features), Prentice Hall 1989.
3. Yashwant Kanetkar: Let Us C, 8th Edition, B P B Publications 2007.
4. E. Balagurusamy: Programming in C (ANSI), 4th Edition, Tata Mac Graw Hill.

**PRACTICAL**

The break-up of marks for third Semester's Practical will be as under:			
Sr. No.	Argument	Maximum Marks	Minimum Passing Marks
1.	Lab Record (Internal Assessment)	6	
2.	Viva-voce (External Assessment)	9	
3.	Program Development and Execution (External Assessment)	15	
Total Marks		30	11





बिलासपुर विश्वविद्यालय, बिलासपुर (छत्तीसगढ़)  
SEMESTER SYLLABUS  
M.Sc. MATHEMATICS

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SEMESTER-IV  
PAPER- IV (OPTIONAL)  
FUZZY SETS AND THEIR APPLICATIONS-II

Possibility Theorem- Fuzzy measures, evidence theory, possibility theory versus probability theory

Fuzzy Logic- An overview of classical logic, Multivalued logics, Fuzzy propositions, Fuzzy quantifiers, Linguistic Hedges, Inference from conditional and qualified fuzzy proposition, the compositional rule of inference.

Approximate reasoning-An overview of fuzzy expert systems, Fuzzy implications and their selection, Multi conditional approximate reasoning, the role of fuzzy relation equations

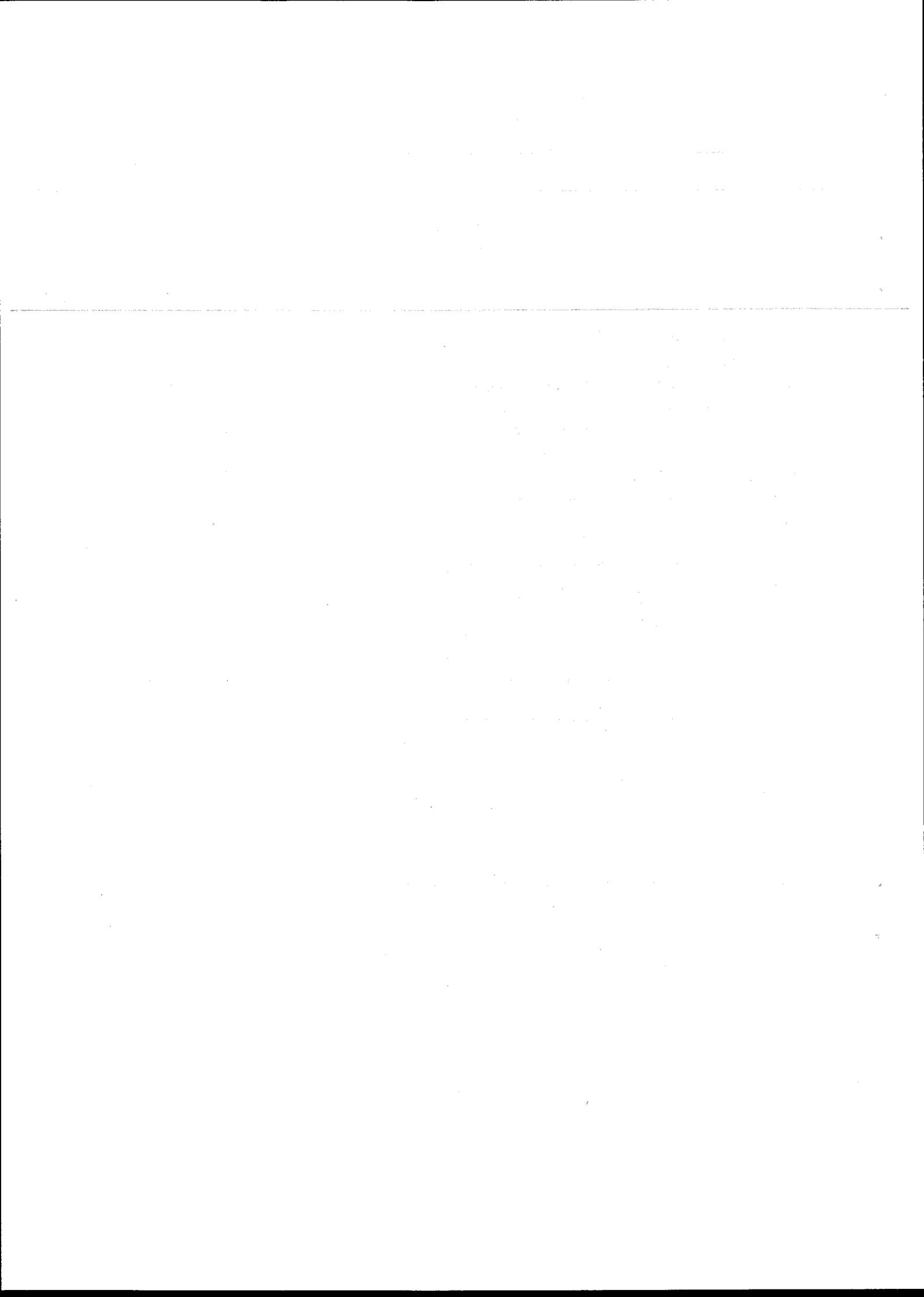
An introduction to fuzzy control- Fuzzy controllers, Fuzzy rule base, Fuzzy inference engine, Fuzzification, Defuzzification and various Defuzzification methods (the centre of area, the centre of maxima, and the mean of maxima methods.)

Decision Making in Fuzzy Environment-Individual decision making, Multi person decision making, Multi criteria decision making, Multistage decision making, Fuzzy ranking methods, Fuzzy linear programming

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**REFERENCES:**

1. G.J. Klir and B. Yuan : Fuzzy Sets and Fuzzy logic, Prentice Hall of India New Delhi
2. H.J. Zimmermann : Fuzzy Sets and Fuzzy logic, Prentice Hall of India New Delhi





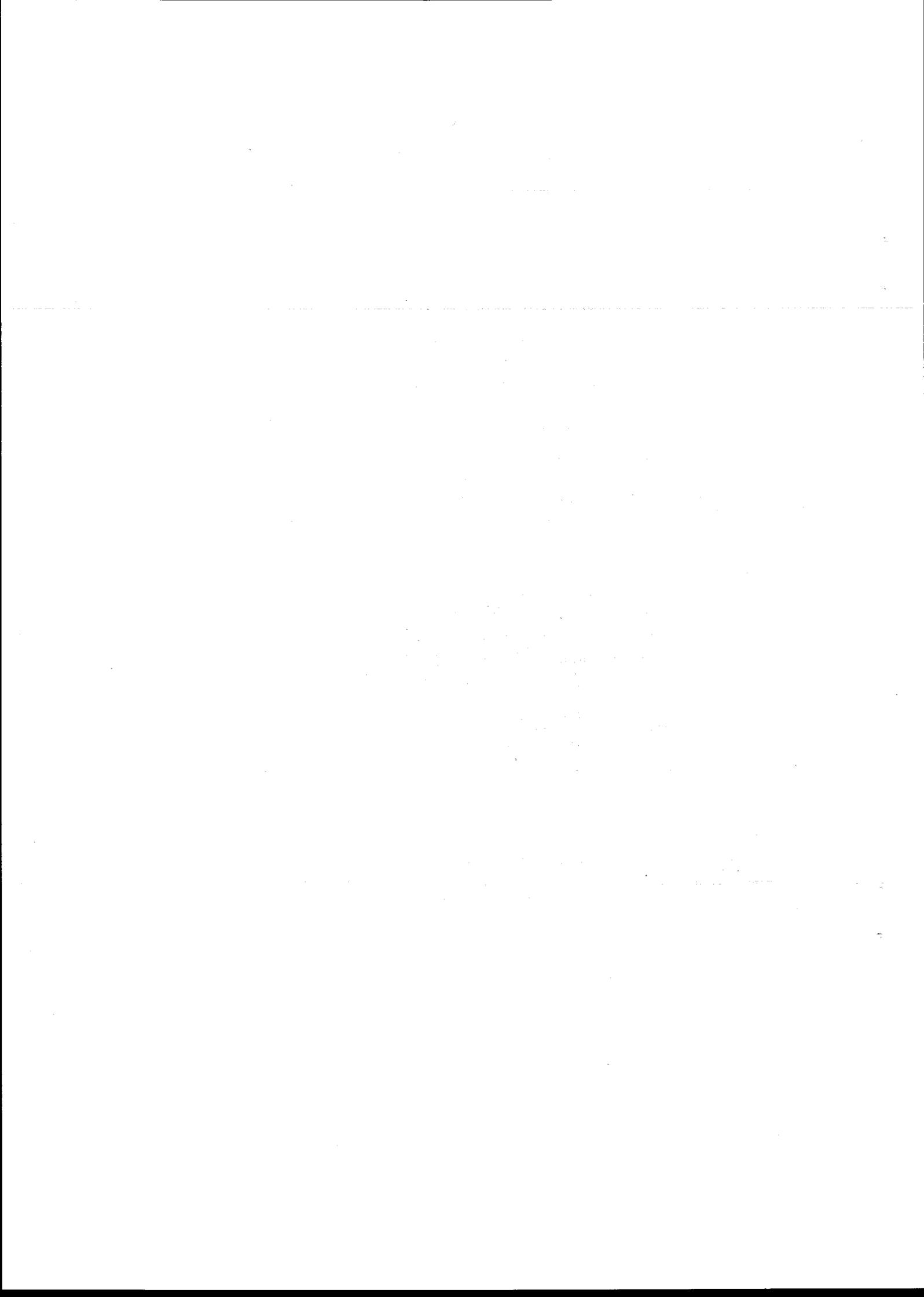
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M.Sc. MATHEMATICS

SEMESTER- IV  
PAPER-V (OPTIONAL)  
OPERATION RESEARCH- II

Dynamic Programming– Deterministic and Probabilistic Dynamic programming  
Game Theory– Two–Person, Zero-Sum Games, Games with Mixed Strategies,  
Graphical Solution, Solution by Linear Programming.  
Integer Programming– Branch and Bound Technique.  
Queueing system- Deterministic Queueing system, probability distribution in Queueing,  
classification of Queueing models, Poission Queueing system ((M/M/I): ( $\infty$ /FIFO),  
(M/M/I): (/SIRO) (M/M/I): (N/FIFO)), Inventory control : The concept of EOQ,  
Deterministic inventory problem with no shortages.  
Nonlinear Programming– One/ Multi-Variable Unconstrained Optimization, Kuhn-Tucker  
Conditions for Constrained Optimization, Quadratic Programming, Separable  
Programming, Convex Programming, Non-convex Programming.

**REFERENCES:**

1. F.S. Hillier and G.J. Ueberman: Introduction to Operations ResBareft (Sixth Edition), McGraw Hill International Edition, Industrial Engineering Series, 1995 Affiliated East-West Press Pvt. Ltd., New Delhi, Madras.
2. G. Hadley: Linear Programming, Narosa Publishing House, 1995.
3. G. Hadly, Nonlinear and Dynamic Programming, Addison-Wesley, Reading Mass.
4. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali: Linear Programming and Network flows, John Wiley I' & Sons, New York, 1990.
5. H.A. Taha: Operations Researc~-An introduction, Macmillan Publishing Co., Inc., New Yark.
6. K. Swarup, P.K. Gupta and M. Mohan: Operations Research, Sultan Chand & Sons, N.Delhi.
7. S.S. Rao: Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.
8. P. K..Gupla and D.S. Hira, : Operations Research ,S. Chand & Co. Ltd., N.Delhi.
9. N.S. Kambo, Mathematical Programming Techniques, Affiliated East-West Press Pvt. Ltd., New Delhi, Madras.
10. S.D.Sharma: Operations Research, KedarNath Ram Nath Publication, Meerut.





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SEMESTER SYLLABUS  
M.Sc. MATHEMATICS

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SEMESTER-IV  
PAPER- VI (OPTIONAL)  
FLUID MECHANICS- II

Motion of Elliptic Cylinder- Streaming Past a fixed Elliptic cylinder, Rotating Elliptic cylinder, Kinetic Energy, Circulation.

Motion in Three Dimensions- Motion of a sphere in a liquid at rest at infinity, Liquid streaming Past a Fixed sphere, Concentric spheres, Equation of motion of a sphere, Stoke's stream function.

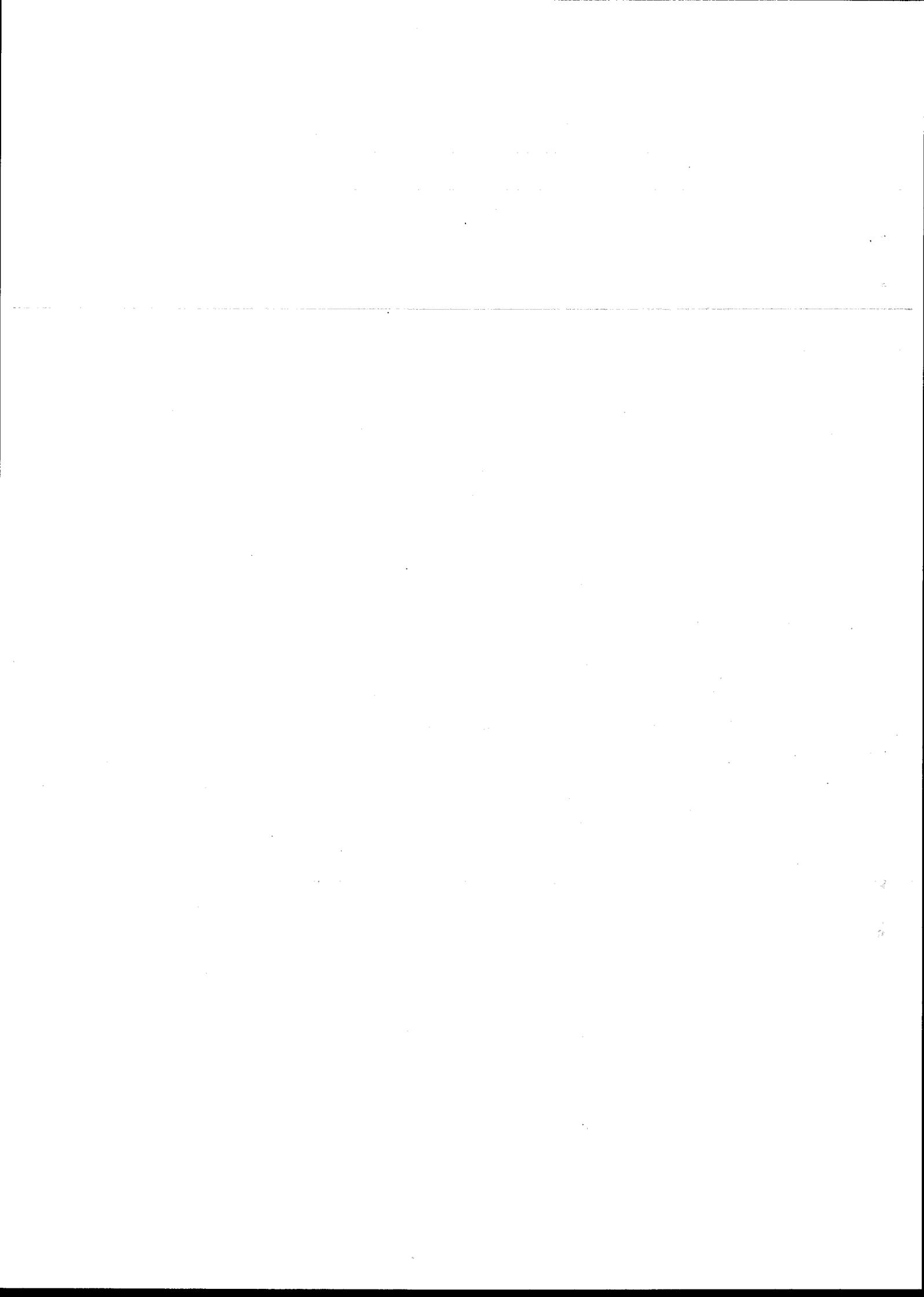
Vortex Motion- Vortex motion and its elementary properties, Kelvin's proof, Conservation of Velocity, Strength of a Vortex Tube, Rectilinear vortices with circular and elliptical section, Pressure distribution, Rankine Combine Vortex, Vortex Pair, Image of a vortex filament in a plane, Karman street.

Wave motion of an Ideal Fluid- Wave motion of an Ideal Fluid and its properties, Progressive waves on the surface of a Canal and Deep Canal, Standing waves, Energy of Progressive Waves, Reduction of Progressive waves to a steady motion, Capillary waves, Waves at an Interface with surface free, Long gravity waves, Group velocity, Paths of Particles.

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**REFERENCES:**

1. A.S.Ramsey: Treatise on Hydrodynamics Part II, CBS Publication, Delhi
2. F.Choriton: Text book of Fluid Mechanics, CBS Publication, Delhi
3. L.D.Landan & E.M.Lipschitz: Fluid Mechanics, Pergamon Press.
4. R.K.Rathy: An Introduction to Fluid Dynamics, Oxford and IBH Company, New Delhi, 1976.





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M.Sc. MATHEMATICS

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SEMESTER-IV  
PAPER- VII (Optional)  
INFORMATION THEORY- II

Information Functions- The general solution of the fundamental equation of information, Derivations and their role in the study of information functions.

Continuous Channels- The time-discrete Gaussian channel. Uncertainty of an absolutely continuous random variable, the converse to the coding theorem for time-discrete Gaussian channel. The time-discrete Gaussian channel, Band limited channels.

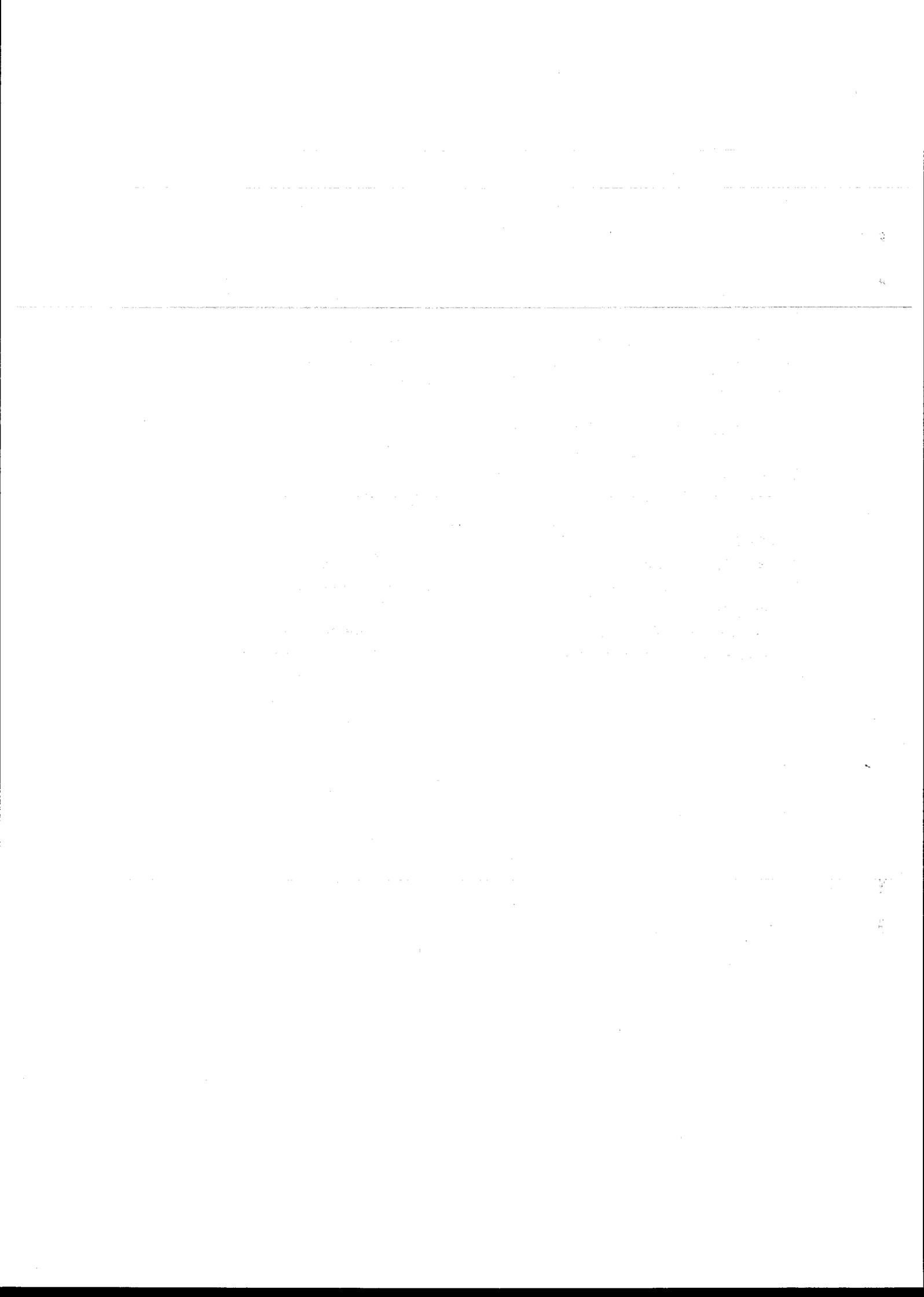
Noiseless Coding- In-gradients of noiseless coding problem, uniquely decipherable codes, Necessary and Sufficient condition for the existence of instantaneous codes, Construction of optimal codes.

Discrete Memory less Channel- Classification of channels, Information processed by a channel, Calculation of channel capacity, Decoding schemes, the ideal observer.

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**REFERENCES:**

1. R.ASH: Information Theory , Inter science Publishers, New York, 1965.
2. F.M.REZA: An Introduction to Information Theory, McGraw Hill Book Company, Inc., 1961
3. J,Aczel and Z.Daroczy: On Measures of Information and their characterization, Academic Press, New York





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SEMESTER SYLLABUS  
M.Sc. MATHEMATICS

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SEMESTER-IV  
PAPER- VIII (OPTIONAL)  
FUNDAMENTALS OF COMPUTER SCIENCE –II

Database System-Role of Database system, Database system Architecture, Introduction to Relational Algebra and Relational Circuits. SQL–Basic features, including views, Integrity constraints, Database design–Normalization up to BCNF. Operating System– User Interface, Processor Management, I/O Management Memory Management, Concurrently and Security, Network and Distributed System.

**REFERENCES:**

1. S.B. Lipman, J.Lajoi: C++ Primer, Addison Wesley.
2. B.Stroustrup: The C++ Programming Language, Addison Wesley.
3. C.J.Date: Introduction to Database System, Addison Wesley.

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