FIRST YEAR
M.Sc MATHEMATICS
PAPER I : ALGEBRA

PART-A

Recapitulation: Groups, Subgroups, Cyclic groups, Normal Subgroups, Quotient group.

Permutation groups, symmetric groups, cycles and alternating groups, dihedral groups,
Homomorphism, Types of homorphisms. Isomorphism theorems and its related
Problems, Automorphisms, Inner automorphisms, groups of automorphisms and inner automorphisms and their relation with centre of a group.

Group action on a set, Orbits and Stabilizers, The orbit –stabilizer theorem, The Cauchy-Frobenius lemma, Conjugacy, Normalizers and Centralizers, Class equation of a finite group and its applications. Sylow's groups and subgroups, Sylow's theorems for a finite group, Applications and examples of p-Sylow subgroups, solvable groups.

Recaptulations: Rings, some special classes of rings(Integral domain,division ring,field).

Homeomorphisms of rings, Kernel and image of Homomorphisms of rings,
Isomorphism of rings, ideals and Quotient rings, Fundamental theorem of homomorphism of rings, Theorems on principle, maximal and prime ideals, Field of quotients of an integral domain Imbedding of rings.

Euclidean rings, Prime and relatively prime elements of a Euclidean ring, Unique factorization theorem, Fermat's theorem, Polynomial rings, The division algorithm. Polynomials over the rational field, Primitive polynomial,Content of a polynomial. Gauss lemma, Eisenstein criteria, polynomial rings over commutative rings.

PART-B

Extension fields, Finite and Algebraic extensions. Degree of extension, Algebraic elements and algebraic extensions, Adjunction of an element of a field. Roots of a polynomial, Splitting fields, Construction with straight edge and compass more about toots, simple and separable extensions.

Elements of Galois Theory, Fixed fields, Normal extension, Galois groups over the rationals.

Basic concepts of vector spaces. Linear transformations and algebra of linear transformations. Regular and singular linear transformations. The range and the rank of a Linear transformation. Characteristic roots and Characteristic vectors of a linear transformation, Matrices of linear transformation, Sylvester's law of inertia.

Canonical forms-Triangular, Nilpotent and Jordan. Types of linear transformation- Hermitian, Unitary and normal transformations.

TEXT BOOKS

1. I N. Herstein:Topics in Algebra, 2nd Edition, Vikas Publishing House, 1976.
2. Surjeet Singh and Qazi Zameeruddin, Modern Alegebra, Vikas Publishing House, 1994
3. N. Jacobson: Basic Algebra-I, HPC,1984.
4. I.N.Herstein:Topics in Algebra, 2nd Edition, Vikas publishing House, 1976.
5. J.B.Fraleigh: Afirst couses in Algebra, 3rd edition, Narosa 1996.

REFERENCE BOOKS

1. M.Artin:Algebra, Prentice Hall of India,1991
2. Darek F.Holt, Bettina Eick and Eamonaa. Obrien. Handbook of computational
   Group theory, Chapman &Hall/CRCPress,2005
3. J.B.Fraleigh: Afirst course in Algebra, 3rd Edition,Narosa,1996.
4. M.Artin: Algebra, Prentice Hall of India,1991.
5. N.Jacobson: Basic Algebra-I, HPC, 1984.

Pattern of Question Paper: The Question paper contains 2sections namely, Part-A and part-B each part contains 4 questions. Five full questions are to be answered in all out of 8 questions choosing atleast 2 from each part.

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PAPER-II :REALAND COMPLEX ANALYSIS
PART-A

The Riemann-Stieltjes Integral:Definitions and existence of the integral, Linear
Properties of the integral, the integral as the limit of sums, Integration and Differentiation, Integration of vactor valued functions. Functions of bounded variation- First and second mean value Theorems, Change of variable rectifiable curves.

Sequence and series of Functions: Pointwise and Uniform Convergence, Cauchy Criterion for uniform convergence, Weirstrass M-test, Uniform convergence and continuity, Uniform convergence and Riemann- Stieltjes Integration, Uniform convergence Differentiation. Uniform convergence and bounded variation-Equacontinous families functions, uniform convergence and bounded ness, The stone- Weir Strauss theorem and Weirstrauss approximation of continuous function, function, illustration of theorem and Weirstrauss approximation of continuous function, illustration of theorem with examples- properties of power series, exponential and logarithmic functions, trigonometric functions.
Toplogy of R'', K-cell and its compactness, Hein- Borel Theorem. Bozano Weistrauss theorem, Continuity, Compactness and uniform continuity.

Functions of several variables, continuity and differentiation of vector-valued functions, Linear transformation of Rk properties and invertibility, Directional Derivatie, Chain rule, Partial derivative, Hessain matrix. The Inverse Fuctions Theorem and its illustrations with examples. The Implicit Function Theorem and illustration and examples. The Rank theorem illustration and examples.

PART-B

Series, Uniform convergence, Power series, Radius of convergences, Power series representation of Analytic function, Relation between Power series and Analytic function Taylor's series, Laurent's series. Analytic functions, Harmonic conjugates, Elem,entary functions, Mobius Transformation, Conformal mappings, Cauchy's Theorem and Integral formula, Morera's Theorem, Cauchy's Theorem for triangle, rectangle, rectangle, Cauchy's Theorem in a disk, Zeros of Analytic fuctions. The index of a closed curve, counting of algebra. Rational Singularities, poles. Behaviour of an Analytic fuctions at an essential singular point. Entire and Meromorphic functions. The Residue Theorem, Evaluation of Definite integrals, Argument principle, Rouche's Theorem, Schwartz lemma, Open mapping and Maximum modulus theorem and applications, Clonvex functions, Convex fuctions, Hadmard's Three circle theorem.

Phragmen-Lindelof theorem, The Riemann mapping theorem, Weistrass factorization theorem. Harmonic functions, Mean Value theorem. Poisson's formula, Poisson's Integral formula, Jensen's formula, Poisson's- Jensen's formula.

TEXT BOOKS:

1. W.Rudin : Principles of Mathematical Analysis, McGraw Hill, 1983.
2. T. M. Apostol: Mathematical Analysis, 2nd Edition, Narosa, 1988.
3. J.B. Conway : Functions of one complex variable, narosa, 1987.
4. L.V . Ahlfors : Complex Analysis, McGraw Hill, 1986.

REFERENCE BOOKS:

1. S. Goldberg: Methods of Real Analysis, Oxford & IBH, 1970.
2. J. Dieudonne: Treatise on Analysis, Vol. I, Academic Press, 1960.
3. R. Nevanlinna : Alnalystic functions, Springer, 1970
4. E. Hille : Analytic Teory, Vol. I, Ginn. 1959.
5. S.Ponnaswamy: Functions of Complex variable, Narosa Publications

Pattern of question paper : The Question paper consists of sections A, B and C, with 3 questions each in sectons A and B, and 2 questions in sections C. Five full questions out of eight questions are to be answered choosing at least one from each part.

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PAPER-III :TOPOLOGY

PART-A

Finite and Infinite sets. Denumerable and Non denumerable sets, Countable and Uncountable sets. Equivalent sets. Concept of Cardinal numbers, Schroeder-Bernstein Theorem. Cardinal number of a power set-Addition of Cardinal number, Exponential of Cardinal numbers, Examples of Cardinal Arithmetic, Cantor's Theorem. Card X<card P (X). Relations connecting and c. Continuum Hypothesis. Zorn's lemma. Definition of a metric.Bolzano-Weiestrass theorem. Open and closed balls. Cauchy and convergent Sequences. Complete metric spaces. Continuity, Contraction mapping theorem. Banach fixed point theorem, Bounded and totally bounded sets. Cantor's Intersection Theorem. Nowhere dense sets. Baire's category theorem. Isometry. Embedding of a metric space in a complete metric space. Topology: Definition and examples Open and closed sets. Neighborhoods and Limit Points. Closyre, Interior and Boundary of a set. Relative topology. Bascs and sub-bases. Continuity and Homeomorphism, Pasting Lemma. Connected spaces: Definition and examples, connected sets in the real Line, intermediate value theorem, components and path components, local connectedness and path connectedness.

PART-B

Compact spaces, Compact sets in the real line, limit point compactness, sequential compactness and their equivalence for metric spaces. Locally Compact spaces, compactification, Alexandroff's one point compactification. The axioms of countability. First axiom space, Second countable space, Separability and the Lindelof property and their equivalence for metric spaces. The product topology, the metric topology, the quotient toplogy, Product invariant properties for finite products, Projection maps.Separation axioms:T_0- space and T_1 spaces –definitions and examples, the properties are hereditary and topological. Characterisation of T_0- space and T_1 spaces.T_2
- space, unque linit for convergent sequences, Reqularity and the T_3 –axiom. Characterisation of regularity, Metric spaces are T_2 and T_3. Complete regularity, Normality and the T_4-axiom, Metric space is T_4, compact Hausdorff space and regular lindelf spaces are normal. Urysohn's Lemma, Tietze's Exatension Theorem, Complete normality and the T_5 axion.Loxal finiteness, Praracompactness, Normality of a paracompact space, Metrizablitiy, Urysohn metrization theorem.

TEXT BOOK

1. J. R. Munkeres, Topology, 2nd Ed, Pearson Education(India),2001.
2. W.J.Pervin:Founndations of General Topology-Academic Press,1964.
3. J.R.Munkres:Topology-AFirst Coursse-Prentice Hall of India,1996.
4. W.J.Pervin:Foundations of General Topology- Academic Press, 1964.

REFERENCE BOOKS

1.G.F. Simmons:Introduction to Topolofy and Modern. Analysis (McGraw-Hill International Edition). Chapters 9,10,11 and

2. G.J.L.Kelley, General Topogy, Van Nostrand Princetion,1955.
3. J. Dugundji: Topology- Prentice Hall of India,1975
4. G.F.Simmons: Introduction to Topology and Modern Analysis- Tata Mc Graw Hill,1963.
5. J.Dugundji: Topology- Prentice Hall of India, 1955.
6. G.J.L. Kelley, General Topology, Van Nostrand, Princeton,1955.

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PAPER-IV :DIFFERENTIAL EQUATIONS

PART- A

Ordinary differential equations: Linear differential equations of nth order, fundamental sets of solutions, Wronskian-Abel's identity, theorems on linear dependence of solutions,adjoint self- adjoint linear operator, Green's formula, Adjoint equations, the nth order non- homogeneous linear equations- Variation of paramenters-Zeros of solutions- comparison and separation theorems oscillatory and non- oscillatory differential equations.

Fundamental existence and uniqueness theorem. Dependence of solutions on initial conditions, existence and uniqueness theorem for higher order and system of differentialequations- Eigenvalue problems- Sturm Liouville problems-Orthoganality of eigen functions –Eigen function expansion in series of othonormal functions- Green's function method.

Power series solution of linear differential equations- ordinary and singular points of differential equations, Classification into regular singular point; Series solution about an ordinary point and a regular singular point-Frobenius method-Hermite, Laguerre, Chebyshev and Gauss Hypergeometric equationsand their general solutions. Generating function, Recurrence relations, Rodrigue's formula-Orthagonality properties. Behaviour of solution at irregular singular points and the point at infinity.

Linear system of homogeneous and non –homogeneous equations(matrix method) Linear and Non-linear autonomous system of equations-Phase plane- Critical points-stability-Liapunov direct method-Limit cycle and periodic solutions- Bifurcation of plane autonomous systems.

PART-B

First Order Partial Differential Equations:-Basic definitions, Origin of PDEs, Classification, Geometrical interpretation. The Cauchy problem, the method of characteristics for Semi linear, quasi linear and Non-Linear equations, complete integrals, Examples of equations to analytical dynamics, discontinuous solution and shockwaves.

Second Order Partial Differential Equations:- Definitions of Linear and Non-Linear equations, Linear Superposition principle, Classification of second-order linear partial differential equations into hyperbolic and elliptic PDEs, Redution to canonical forms, solution of linear Homogeneous and non-homogeneous with constant constant coefficients, Variable coefficients, Monge's method.

Wave equation:- Solution by the method of separation of variables and integral transforms The Cauchy problem, Wave equation in cylindrical and spherical polar co-ordinates.

Laplace equation:- Solution by the method separation of variables and transforms. Dirchlet's Neumann's and Churchills problems, Dirchlet's problem for a rectangle, half plane and circle, Solution of Laplace eqution in cylindrical and sphyerical polar coordinates

Diffusion equation:- Fundamental solution by the method of variables and integral transforms, Duhamel's principle, Solution of the equation in cylindrical and spherical polar coordinates.

Solution of boundary value problems:-Green's function method for hyperbolic, Parablic and Elliptic equations.

Solution of non-linear PDEs by successive approximation method, similarity transformations, Homotophy method. And variational method.

TEXT BOOKS:

1. G.F. Simmons:Differential Equations, TMH Editioon, New Delhi,1974.
2. M.S.P.Eastham: Theory of ordinary differential equations, Van Nostrand, London, 1970.
3. S.L. Ross: Differential equations(3rd edition),John Wiley &Sons, New York,1984.
4. N.SNEDDON, Elements of PDE's McGraw Hill Book company Inc.
5. L DEBNATH, Nonlinear PDE's for Scientists and Engineers, Birkhauser,
   Boston
6. 3. F. John, Partial differential equations, Springer,1971.

REFERENCE BOOK:

1. E.D. Rainville and P.E.Bedient: Elementary Differential Equations, McGraw Hill, New York,1969.
2. E.A. Coddington and N.Levinson: Theory of ordinary differential equations, McGraw Hill,1955.
3. A.C.King,J. Billingham and S.R Otto: 'Differential equations', camridge University Press, 2006.
4. F. Treves: Basic linear partial differential equations, Academic Press,1975.
5. M.G. Smith: Introduction to the theory of partial differential equations, Van Nastrand,1967.
6. Shankar Rao Partial Differential Equation, PHI

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PAPER -V : DISCRETE MATHEMATICS & COMBINATORICS

PART-A

Introduction to logic. Methods of Proof: Rules of Inference, Valid Arguments, Rules of inference for quantified statements. Methods of proving theorems: Direct proofs, Indirect proofs, proof by contradiction, Proof by Proofs of equivalence.

Basic counting principles, the product rule and the sum rule, Examples to illustrate sum and product rule. The inclusion-exclusion principle and examples. The Pigeonhole Principle and examples.

Recurrence relations, relations, Modeling with recurrence relations with examples of Fibonacci numbers and the tower of Hanoi problem. Divide-and-Conquer relations with examples (no theorems).Difference equations. Difference equations.

Definition and types of relations. Representing relations using matrices and digraphs. Closures of relations, Paths in digraphs, Transitive closures. Warshall's Algorithm. Partial Ordering, Hasse diagrams, Maximal and Minimal elements, Lattices.

PART-B

Enumerations:- Basic counting principles, simple arrangements and selection, arrangements and selections with repetitions, distributions, binomial identities, generating models, calculating coefficients of generating functions, partitions, exponential generating functions. Equivalence and symmetric groups, Burnside theorem, the cycle index, Polya's formula.

Codes:- Elements of coding theory, the Hamming metric, the parity-check and generator metrics, group codes, decoding with coset leaders, hamming matrices, self-orthogonal codes, symmetric codes over F_3, problems, f-augmenting paths, Max nearly perfect binary codes and uniformly packed codes.

<u>TEXT BOOKS</u>:

1. C.L. Liu:Elements of Discrefe Mathematics, Tata Mcgraw –Hill, 2000.
2. Kenneth Rosen, WCB McGraw-Hill, 6^{th} edition, 2004.
3. Alan tucker, "Applied Combinatorics", 4^{th} Ed,John Wiley and Sons,2002.
4. R.P.Grimaldi, "Discrete & Combinatorial Mathematics: An applied introduction", 4^{th} Ed., Pearsons Education Inc., 1999

<u>REFERENCE BOOKS</u>:

1. J.P. Tremblay and R.P.Manohar:Discrete Mathematical Structures with
   applications to computer science,McGraw Hill,1975.
2. F.Harary:Graph Theory, Addition Wesley,1960.
3. Cornelius T Leondes, Control and Dynamic systems, Academic press-2006.
4. J.H.Van Lint and R.M.Wilson:'Acourse on combinatorics', Cambridge
   University Press(2006).

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