

MATHEMATICS

There shall be three theory papers. Two compulsory and one optional. Each paper carrying 50 marks is divided into five units and each unit carry equal marks.

B.A./B.SC. Part-III**PAPER - I
ANALYSIS****METRIC SPACES**

- UNIT-I** Definition and examples of metric spaces. Neighbourhoods, Limit points, Interior points, Open and Closed sets, Closure and interior, Boundary points, Sub-space of a metric space, Cauchy sequences, Completeness, Cantor's intersection theorem, Contraction principle, construction of real numbers as the completion of the incomplete metric space of rationals. Real numbers as a complete ordered field.
- UNIT-II** Dense subsets, Baire Category theorem, Separable, second countable and first countable spaces. Continuous functions, Extension theorem, Uniform continuity, isometry and homeomorphism. Equivalent metrics, Compactness, sequential compactness, Totally bounded spaces, Finite intersection property, Continuous functions and Compact sets, Connectedness, Components, Continuous functions and Connected sets.

COMPLEX ANALYSIS

- UNIT-III** Complex numbers as ordered pairs, Geometrical representation of complex numbers, Stereographic projection, Continuity and differentiability of complex functions, Analytic functions, Cauchy-Riemann equations, Harmonic functions, Elementary functions, Mapping by elementary functions, Mobius transformations, Fixed points, Cross ratio, Inverse points and critical mappings, Conformal mappings.

REAL ANALYSIS

- UNIT-IV** Series of arbitrary terms, Convergence, divergence and oscillation, Abel's and Dirichlet's test, Multiplication of series, Double series, Partial derivation and differentiability of real-valued functions of two variables, Schwarz and Young's theorem, Implicit function theorem, Fourier series, Fourier expansion of piecewise monotonic functions.
- UNIT-V** Riemann integral, Integrability of continuous and monotonic functions, The fundamental theorem of integral calculus, Mean value theorems of integral calculus, Improper integrals and their convergence, Comparison tests, Abel's and Dirichlet' tests, Frullani's integral, Integral as a function of a parameter, Continuity, derivability and integrability of an integral of a function of a parameter.

REFERENCES :

1. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
2. R.R. Goldberg, Real Analysis, Oxford & IBH publishing Co., New Delhi, 1970.
3. S. Lang, Undergraduate Analysis, Springer-Verlag, New York, 1983.
4. D. Somasundaram and B. Choudhary, A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1997.
5. Shanti Narayan, A Course of Mathematical Analysis, S. Chand & Co. New Delhi.
6. P.K. Jain and S.K. Kaushik, An introduction to Real Analysis, S. Chand & Co., New Delhi, 2000.
7. R.V. Churchill and J.W. Brown, Complex Variables and Applications, 5th Edition, McGraw- Hill, New York, 1990.
8. Mark J. Ablowitz and A.S. Fokas, Complex Variables : Introduction and Applications, Cambridge University Press, South Asian Edition, 1998.
9. Shanti Narayan, Theory of Functions of a Complex Variable, S. Chand & Co., New Delhi.
10. E.T. Copson, Metric Spaces, Cambridge University Press, 1968.
11. P.K. Jain and K. Ahmad, Metric Spaces, Narosa Publishing House, New Delhi, 1996.
12. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 1963.

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B.A./B.SC. Part-III

PART - II ABSTRACT ALGEBRA

- UNIT-I Group- Automorphisms, inner automorphism. Automorphism of groups and their computations, Conjugacy relation, Normaliser, Counting principle and the class equation of a finite group. Center for Group of prime-order, Abelianizing of a group and its universal property. Sylow's theorems, Sylow subgroup, Structure theorem for finite Abelian groups.
- UNIT-II Ring theory-Ring homomorphism. Ideals and quotient rings. Field of quotients of an integral domain, Euclidean rings, polynomial rings, Polynomials over the rational field. The Eisenstien criterion, polynomial rings over commutative rings, Unique factorization domain. R unique factorisation domain implies so is $R[x_1, x_2, \dots, x_n]$. Modules, Submodules, Quotient modules, Homomorphism and Isomorphism theorems.
- UNIT-III Definition and examples of vector spaces. Subspaces. Sum and direct sum of subspaces. Linear span, Linear dependence, independence and their basic properties. Basis. Finite dimensional vector spaces. Existence theorem for bases. Invariance of the number of elements of a basis set. Dimension. Existence of complementary subspace of a finite dimensional vector space. Dimension of sums of subspaces. Quotient space and its dimension.
- UNIT-IV Linear transformations and their representation as matrices. The Algebra of linear transformations. The rank nullity theorem. Change of basis. Dual space. Bidual space and natural isomorphism. Adjoint of a linear transformation. Eigenvalues and eigenvectors of a linear transformation. Diagonalisation. Annihilator of a subspace. Bilinear, Quadratic and Hermitian forms.
- UNIT-V Inner Product Spaces-Cauchy-Schwarz inequality. Orthogonal vectors. Orthogonal Complements. Orthonormal sets and bases. Bessel's inequality for finite dimensional spaces. Gram-Schmidt Orthogonalization process.

REFERENCES :

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. N. Jacobson, Basic Algebra, Vols. I & II. W.H. Freeman, 1980 (also published by Hindustan Publishing Company).
3. Shanti Narayan, A Text Book of Modern Abstract Algebra, S.Chand & Co. New Delhi.
4. K.B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
5. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra (2nd Edition) Cambridge University Press, Indian Edition, 1997.
6. K. Hoffman and R. Kunze, Linear Algebra, (2nd Edition), Prentice Hall. Englewood Cliffs, New Jersey, 1971.
7. S.K. Jain, A. Gunawardena and P.B. Bhattacharya, Basic Linear Algebra with MATLAB. Key College Publishing (Springer-Verlag) 2001.
8. S. Kumaresan, Linear Algebra, A Geometric Approach, Prentice-Hall of India, 2000.
9. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1997.
10. I.S. Luther and I.B.S.Passi, Algebra, Vol. I-Groups, Vol. II-Rings. Narosa Publishing House (Vol. I-1996, Vol. II-1999)
11. D.S. Malik, J.N. Mordeson, and M.K. Sen, Fundamentals of Abstract Algebra, McGraw- Hill International Edition, 1997.

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B.A./B.SC. Part-III
PAPER - III - (OPTIONAL)
(II) DISCRETE MATHEMATICS

- UNIT-I** Sets and Propositions - Cardinality. Mathematical Induction, Principle of inclusion and exclusion. Computability and Formal Languages - Ordered Sets. Languages. Phrase Structure Grammars. Types of Grammars and Languages. Permutations. Combinations and Discrete Probability.
- UNIT-II** Relations and Functions - Binary Relations, Equivalence Relations and Partitions. Partial Order Relations and Lattices. Chains and Antichains. Pigeon Hole Principle.
- Graphs and Planar Graphs - Basic Terminology. Multigraphs. Weighted Graphs. Paths and Circuits. Shortest Paths. Eulerian Paths and Circuits. Travelling Salesman Problem. Planner Graphs. Trees.
- UNIT-III** Finite State Machines - Equivalent Machines. Finite State Machines as Language Recognizers. Analysis of Algorithms - Time Complexity. Complexity of Problems. Discrete Numeric Functions and Generating Functions.
- UNIT-IV** Recurrence Relations and Recursive Algorithms - Linear Recurrence Relations with constant coefficients. Homogeneous Solutions. Particular Solution. Total Solution. Solution by the Method of Generating Functions. Brief review of Groups and Rings.
- UNIT-V** Boolean Algebras - Lattices and Algebraic Structures. Duality, Distributive and Complemented Lattices. Boolean Lattices and Boolean Algebras. Boolean Functions and Expressions. Propositional Calculus. Design and Implementation of Digital Networks. Switching Circuits.

REFERENCES :

1. C.L. Liu, Elements of Discrete Mathematics, (Second Edition), McGraw Hill, International Edition, Computer Science Series, 1986

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