

**BM-351**  
**(Semester-V)**  
**Real Analysis**

External Marks: 40/27

Internal Marks: 10/6

Time: 3 Hours

**Note: Paper setter will set nine questions in all, selecting two questions from each section and one Compulsory question consisting of five parts distributed over all four sections. Candidates are required To attempt five questions, selecting at least one question from each section and the compulsory Question.**

**Section-I**

Riemann integral, Integrability of continuous and monotonic functions, The Fundamental theorem of integral calculus. Mean value theorems of integral calculus.

**Section-II**

Improper integrals and their convergence, Comparison tests, Abel's and Dirichlet's tests, Frullani's integral, Integral as a function of a parameter. Continuity, Differentiability and integrability of an integral of a function of a parameter.

**Section-III**

Definition and examples of metric spaces, neighborhoods, limit points, interior points, open and closed sets, closure and interior, boundary points, subspace of a metric space, equivalent metrics, Cauchy sequences, completeness, Cantor's intersection theorem, Baire's category theorem, contraction Principle

**Section-IV**

Continuous functions, uniform continuity, compactness for metric spaces, sequential compactness, Bolzano-Weierstrass property, total boundedness, finite intersection property, continuity in relation with compactness, connectedness, components, continuity in relation with connectedness.

## REFERENCES

- P.K. Jain and Khalil Ahmad: Metric Spaces, 2 nd Ed., Narosa, 2004
- T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
- R.R. Goldberg : Real analysis, Oxford & IBH publishing Co., New Delhi, 1970
- D. Somasundaram and B. Choudhary : A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1997
- Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi
- E.T. Copson, Metric Spaces, Cambridge University Press, 1968.
- G.F. Simmons : Introduction to Topology and Modern Analysis, McGraw Hill, 1963.

**BM-352**  
**(Semester-V)**  
**Groups and Rings**

External Marks: 40/27

Internal Marks: 10/6

Time: 3 Hours

**Note: Paper setter will set nine questions in all, selecting two questions from each section and one Compulsory question consisting of five parts distributed over all four sections. Candidates are required To attempt five questions, selecting at least one question from each section and the compulsory Question.**

**Section-I**

Definition of a group with example and simple properties of groups, Subgroups and Subgroup criteria, Generation of groups, cyclic groups, Cosets, Left and right cosets, Index of a sub-group Coset decomposition, Lagrange's theorem and its consequences, Normal subgroups, Quotient groups,

**Section-II**

Homomorphisms, isomorphisms, automorphisms and inner automorphisms of a group. Automorphisms of cyclic groups, Permutations groups. Even and odd permutations. Alternating groups, Cayley's theorem, Center of a group and derived group of a group.

**Section-III**

Introduction to rings, subrings, integral domains and fields, Characteristics of a ring. Ring homomorphisms, ideals (principal, prime and Maximal) and Quotient rings, Field of quotients of an integral domain.

**Section-IV**

Euclidean rings, Polynomial rings, Polynomials over the rational field, The Eisenstein's criterion, Polynomial rings over commutative rings, Unique factorization domain,  $R$  unique factorization domain implies so is  $R[X_1, X_2, \dots, X_n]$

## REFERENCES

- I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
- P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2 nd edition).
- Vivek Sahai and Vikas Bist : Algebra, NKarosa Publishing House.
- I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Norsa Publishing House.

**BM-353**  
**(Semester-V)**  
**NUMERICAL ANALYSIS**

External Marks: 40/27

Internal Marks: 10/6

Time: 3 Hours

**Note: Paper setter will set nine questions in all, selecting two questions from each section and one Compulsory question consisting of five parts distributed over all four sections. Candidates are required To attempt five questions, selecting at least one question from each section and the compulsory Question.**

**Section-I**

Finite Differences operators and their relations. Finding the missing terms and effect of error in a difference tabular values, Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Interpolation with unequal intervals: Newton's divided difference, Lagrange's Interpolation formulae, Hermite Formula.

**Section-II**

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula. Probability distribution of random variables, Binomial distribution, Poisson's distribution, Normal distribution: Mean, Variance and Fitting.

**Section-III**

Numerical Differentiation: Derivative of a function using interpolation formulae as studied in Sections –I & II. Eigen Value Problems: Power method, Jacobi's method, Given's method, Householder's method, QR method, Lanczos method.

**Section-IV**

Numerical Integration: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one- third and three-eighth rule, Chebychev formula, Gauss Quadrature formula. Numerical solution of ordinary differential equations: Single step methods Picard's method. Taylor's series method, Euler's method, Runge-Kutta Methods. Multiple step methods; Predictor-corrector method, Modified Euler's method, Milne-Simpson's method.

**Part-B (Practical)**

Implementation of numerical methods, studied in the theory paper, in 'C' Programming Language.

## REFERENCES

- M.K. Jain, S.R.K. Lyengar, R.K. Jain : Numerical Method, Problems and Solutions, New Age International (P) Ltd., 1996
- M.K. Jain, S.R.K. Lyengar, R.K. Jain : Numerical Method for Scientific and Engineering Computation, New Age International (P) Ltd., 1999
- C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
- Melvin J. Maaron : Numerical Analysis-A Practical Approach, Macmillan Publishing Co., Inc., New York
- R.Y. Rubnistein : Simulation and the Monte Carlo Methods, John Wiley, 1981
- Computer Oriented Numerical Methods, Practice Hall of India Pvt. Ltd.