

## **Admission Criteria and Mode of Admission:**

### **(1) Ph.D. Course:**

Admission to the Ph.D. programme in Mathematics shall be made strictly according to Research Entrance Test (RET) merit against the available seats in the Department. For details please see the Information Brochure and Rule & Regulations for Ph.D. programme.

## **Syllabus for Research Entrance Test (RET)**

### **Unit – I: Real Analysis**

Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum, Sequence and series, convergence, limsup, liminf, Bolzano Weierstrass theorem, Heine Boral theorem, continuity, uniform continuity, differentiability, mean value theorem, sequences and series of functions, uniform convergence, Riemann sums and Riemann integral, improper integrals.

Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral, functions of several variables, directional derivative, partial derivative, derivative as a linear transformation.

Metric spaces, compactness, connectedness, Normed linear spaces, spaces of continuous functions as examples.

### **Unit – II: Linear Algebra**

Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations, algebra of matrices, rank and determinant of matrices, linear equations, eigenvalues and eigenvectors, Cayley-Hamilton theorem, matrix representation of linear transformations, change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms, inner product spaces, orthonormal basis, quadratic forms, reduction and classification of quadratic forms.

### **Unit – III: Complex Analysis**

Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions, analytic functions, Cauchy-Riemann equations, Contour integral,

Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, maximum modulus principle, Schwartz lemma, open mapping theorem, Taylor series, Laurent series, calculus of residues, conformal mappings, Mobius transformations.

#### **Unit – IV: Algebra**

Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements, fundamental theorem of arithmetic, divisibility in  $\mathbb{Z}$ , congruences, Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutations groups, Cayley's theorem, class equations, Sylow theorems, Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain, polynomial rings and irreducibility criteria, fields, finite fields, field extensions.

#### **Unit – V: Differential Equations**

Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs, general theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs, and classification of second order linear PDEs, method of separation of variables of Laplace, heat and wave equations.

#### **Unit – VI: Numerical Analysis**

Numerical solutions of algebraic equations, method of iteration and Newton-Raphson method, rate of convergence, solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, numerical solution of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods, finite differences method.

#### **Unit – VII: Calculus of Variations and Linear Integral Equations**

Variation of a functional, Euler-Lagrange equation, necessary and sufficient conditions for extrema, variational methods for boundary value problems in ordinary and partial differential equations.

Linear integral equation of the first and second kind of Fredholm and Volterra type, solutions with separable kernels, characteristic numbers and eigenfunctions, resolvent kernel.

#### **Unit – VIII: Graph Theory**

Graphs, subgraphs, digraphs, connectedness, Euler graph, trees, spanning trees, connectivity and separability, isomorphism, planar graph, matrices associated with a graph, chromatic partitioning and chromatic polynomial.

### **Unit – IX: Operation Research**

Linear programming problem, Simplex method, two phase method, Big –M method, inventory models with and without shortages, inventory control with price breaks, Queuing theory, steady state solution of Markov Queuing models: M/M/1 and M/M/C.

Convex sets and convex functions, K-T conditions, quadratic programming.

### **Unit – X: Statistics**

Sample space, discrete probability, independent events, Bayes' Theorem, random variables and distribution functions, expectation and moments, independent random variables, Standard discrete and continuous univariate distributions, Poisson, Binomial and Normal distributions. Methods of estimation, Z-test, T-test, Chi-square test, F-test. Curve fitting, regression and correlation.

## **(2) P.G. Course:**

Students seeking their admission in M.A. / M.Sc. mathematics have to qualify an entrance examination to be conducted by University.

## **Syllabus for Entrance Examination M.A./M.Sc. Mathematics**

### **Real Analysis**

Sequence and series of real numbers, continuous function and differentiability of real valued function, R-integrability, compactness and connectedness, Fourier series.

### **Differential calculus**

Partial differential, Maxima and minima of function of one and two variables.

### **Integral calculus**

Integration, Definite integrals, Differential equations of first order, Linear differential equations of higher order with constant coefficients.

### **Algebra**

Groups, Rings, Fields and vector spaces. Algebra of Matrix, Rank and inverse of Matrix consistency and solution of system of linear equations, Eigen values and eigenvectors.

**3-D (Solid Geometry)**

Plane and Straight line.

**General Awareness & Logic Ability**

**(3) U.G.Course:**

Admission in B.Sc. is based on merit.