

## **PG Entrance Syllabus for Mathematics-2023**

### **Unit-I**

Limit and Continuity ( $\epsilon$  and  $\delta$  definition), types of discontinuities, properties of continuous functions on closed intervals, differentiability of functions, Successive differentiation, Leibnitz's theorem, partial differentiation, total differentials, Euler's theorem on homogenous functions.

### **Unit-II**

Tangents and normals (polar coordinates only), pedal equations, curvature and radius of curvature, asymptotes, singular points, tracing of curves in cartesian and polar coordinates.

### **Unit-III**

Rolle's theorem, Mean value theorems, Taylor's theorem with Lagrange's Cauchy's forms of remainder, Taylor's series, Maclaurin's series of  $\sin x$ ,  $\cos x$ ,  $x^m e^x$ ,  $\log(1+x)$ ,  $(1+x)^n$  and other functions, maxima and minima, indeterminate forms.

### **Unit-IV**

Integration by partial fractions, integration of rational and irrational functions, definite integrals and their properties, reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and of their combinations.

### **Unit- V**

Differential equations, integrating factors, Bernoulli's equation, exact differential equations, necessary and sufficient conditions for exactness, symbolic operators, homogeneous and non-homogeneous linear differential equations with constant coefficients and those reducible to such equations.

### **Unit-VI**

Miscellaneous forms of differential equations, first order higher degree equations solvable for  $X$ ,  $Y$ ,  $Z$ ,  $P$  equations from which one variable is explicitly absent, Clairut's form, equations reducible to Clairut's form.

### **Unit-VII**

Legendre polynomials, Bessel function, recurrence relation and differential equation satisfied by each of these functions, Wronskian and its properties

### **Unit-VIII**

Formation of partial differential equations, order and degree of partial differential equations, concept of linear and non-linear partial differential equations, linear partial differential equation of first order, Lagrange's method, Geometrical interpretation of the form  $Pp + Qq = R$ , Charpit's method, classification of second order partial differential equations into elliptical, parabolic and hyperbolic through illustrations only.

### **Unit-IX**

Finite and infinite sets, examples of countable and uncountable sets, real line, bounded sets, suprema and infima, completeness property of  $\mathbb{R}$ , Archimedean property of  $\mathbb{R}$ , intervals, concept of cluster points and statement of Bolzano-Weierstrass theorem.

### **Unit-X**

Real sequence, bounded sequence, Cauchy convergence criterion of sequences, Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

### **Unit-XI**

Infinite series, Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, alternating series, Leibnitz's test, definition and examples of absolute, conditional and uniform convergence.

### **Unit-XII**

Sequences and series of functions, point wise and uniform convergence, Mn-test, M-test, statements of the results about uniform convergence and integrability and differentiability of functions, power series and radius of convergence.

### **Unit-XIII**

Definition and examples of groups, examples of abelian and non-abelian groups, the group  $Z_n$  of integers under addition modulo  $n$  and group  $U(n)$  of units under multiplication modulo  $n$ . Cyclic groups from number systems, complex roots of unity, circle group, the general linear group  $GL_n(N, r)$ , groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle and (iv) a square, the permutation group  $Sym(n)$ , groups of quaternions.

### **Unit-XIV**

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, index of subgroup, Lagrange's theorem, order of an element. Normal subgroups: their definition, examples, and characterizations, Quotient groups.

### **Unit-XV**

Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems,  $Z_n$  the ring of integers modulo  $n$ , ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions, subrings and ideals, integral domain and fields, examples of fields:  $Z_p$ ,  $Q$ ,  $R$  and  $C$ . Field of rational functions.