

## **Topics that will be evaluated in the Math Qualifier Exam**

### **Algebra:**

#### *Complex Numbers and Quadratic Equations*

Motivation behind complex numbers, especially in relation to solving quadratic equations, properties of complex numbers, Argand plane.

#### *Sequence and Series*

Arithmetic Progression (A.P), Geometric Progression (G.P), general terms of these series, sum of  $n$  terms of these series, infinite series, arithmetic-geometric series, arithmetic mean, geometric mean, and harmonic mean, relation between arithmetic mean and geometric mean.

#### *Trigonometry*

Basic understanding of trigonometric functions, measure angles in radian and in degree (interconversion), positive and negative angles, sign of trigonometric functions in different quadrants, basic trigonometric identities, simple problems of height and distance, trigonometric formula for complementary and supplementary angles, expressing  $\sin(x \pm y)$  and  $\cos(x \pm y)$  in terms of  $\sin x$ ,  $\sin y$ ,  $\cos x$  &  $\cos y$  and other their simple applications. Other trigonometric formula on sum and difference of angles, half-angle formula, formulas for twice the angles and thrice the angles etc., basics of trigonometric equations.

### **Calculus:**

#### *Sets:*

Sets and their representations, subsets, proving equality of two sets, subsets of real numbers, concept of open and closed intervals, empty set, universal set, Venn diagram, set operations- Union, intersection, difference, complement, symmetric difference and their properties.

#### *Relations and functions:*

Ordered pairs, Cartesian product and its representation, relations, types of relations, equivalence classes, functions as a special type of relations, concepts of domain, co-domain, and range/image, mapping, different kinds of functions such as injective, surjective, bijective functions, Real valued functions, domain and range of these functions, constant, identity, polynomial, rational, modulus, signum, exponential, logarithmic and greatest integer functions, trigonometric functions with their graphs. Sum, difference, product and quotients of functions.

#### *Limits:*

Definition of limit, left limit, right limit, properties of limit, finding limits of different kinds of functions such as Limits of polynomials and rational functions trigonometric, exponential and logarithmic functions.

#### *Continuity:*

Definition(s) of continuity using the definition of limit, concepts of left limit and right limit, proving continuity of a function.

### *Derivatives:*

Understanding of derivative as a rate of change, definition of derivative using limit, definition of derivative as a tangent to the curve at a point, derivative of sum, difference, product, and quotients of a function. Finding derivatives of different kind of functions such as polynomials, rational functions, and trigonometric functions.

### *Continuity and Differentiability:*

Continuity and differentiability, chain rule, derivative of inverse trigonometric functions, derivative of implicit functions. Concept of exponential and logarithmic functions. Derivatives of logarithmic and exponential functions. Logarithmic differentiation, derivative of functions expressed in parametric forms. Higher order derivatives.

### *Applications of Derivatives:*

Concept of monotonically increasing and decreasing functions, maxima and minima, test for maxima and minima for continuous functions, extreme value theorem, mean value theorem and their applications,

### *Integrals:*

Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts, standard integrals, Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals.

### *Applications of the Integrals:*

Applications in finding the area under simple curves, especially lines, circles/ parabolas/ellipses (in standard form only)

### *Differential Equations:*

Definition, order and degree, general and particular solutions of a differential equation. Solution of differential equations by method of separation of variables, solutions of homogeneous differential equations of first order and first degree. Solutions of linear differential equation of the type:

$dy/dx + py = q$ , where  $p$  and  $q$  are functions of  $x$  or constants.

$dx/dy + px = q$ , where  $p$  and  $q$  are functions of  $y$  or constants.