

# Pre-Calculus

## Gyaanbhoomi Academic Curriculum

### Course Description

Pre-Calculus is designed to prepare students for calculus and other advanced mathematics courses. The curriculum synthesizes concepts from algebra and geometry, focusing on the comprehensive study of functions, including polynomial, rational, exponential, logarithmic, and trigonometric functions. Additional topics include vectors, polar coordinates, and an introduction to limits.

### Topics Covered

#### Unit 1: Functions and Graphs

- In-depth Analysis of Parent Functions and Transformations
- Composition and Inverses of Functions
- Graphing Polynomial and Rational Functions
- Piecewise-Defined Functions

#### Unit 2: Exponential and Logarithmic Functions

- Properties and Graphs of Exponential and Logarithmic Functions
- Solving Exponential and Logarithmic Equations
- Applications in Growth, Decay, and Finance (Compound Interest)
- The Natural Base,  $e$ , and Logarithmic Scales

#### Unit 3: Trigonometric Functions

- The Unit Circle Approach to Trigonometry
- Radian and Degree Measure
- Graphs of all Six Trigonometric Functions ( $\sin$ ,  $\cos$ ,  $\tan$ ,  $\csc$ ,  $\sec$ ,  $\cot$ )
- Modeling with Sinusoidal Functions (Amplitude, Period, Phase Shift)

#### Unit 4: Analytic Trigonometry

- Fundamental Trigonometric Identities (Reciprocal, Pythagorean, Quotient)
- Verifying Identities and Solving Trigonometric Equations
- Sum, Difference, Double-Angle, and Half-Angle Formulas
- Inverse Trigonometric Functions and their Domains/Ranges

**Unit 5: Applications of Trigonometry**

- The Law of Sines and The Law of Cosines
- Vectors in the Plane (Component Form, Magnitude, Direction)
- The Dot Product and the Angle Between Two Vectors
- Parametric Equations

**Unit 6: Polar Coordinates and Complex Numbers**

- Plotting Polar Coordinates and Graphing Polar Equations
- Conversion between Polar and Rectangular Forms
- Trigonometric (Polar) Form of Complex Numbers
- DeMoivre's Theorem and Nth Roots of Complex Numbers

**Unit 7: Analytic Geometry and Conic Sections**

- Analysis of Conic Sections: Parabola, Ellipse, Hyperbola
- Rotated Conics and the Discriminant
- Solving Systems of Non-Linear Equations

**Unit 8: Sequences, Series, and Probability**

- Arithmetic and Geometric Sequences and Series
- The Binomial Theorem and Pascal's Triangle
- Mathematical Induction
- Basic Combinatorics and Probability

**Unit 9: Introduction to Calculus**

- Intuitive Understanding of Limits
- Finding Limits Graphically and Numerically
- The Tangent Line Problem and the Definition of the Derivative:  $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$
- Introduction to Area Under a Curve