

## Section A

- Combinatorics
  1. Basic Counting (Rule of Sum, Rule of Product, Combinations, Permutations, Principle of Inclusion-Exclusion)
  2. Pigeonhole Principle
  3. Induction and Proof by Contradiction
  4. Elementary Recurrence Relations and Characteristic Equations
  5. Generating Functions and Binomial Theorem
  
- Algebra
  1. Linear Equations, Quadratic Equations
  2. Polynomials over known rings ( $\mathbb{Z}$ ,  $\mathbb{Q}$ ,  $\mathbb{R}$  or  $\mathbb{C}$ ).
  3. Classical Inequalities (AM-GM, Cauchy-Schwartz, Rearrangement, Schur's Inequality)
  4. Exponents, Logarithms and Trigonometric Functions
  5. Complex Numbers (De-Moivre, Polar Coordinates, Conjugates, and basic properties)
  6. Sequence and Series (Arithmetic Progressions, Geometric Progression, Harmonic Progression etc.)
  
- Geometry
  1. Euclidean Geometry (Triangle Geometry, Cyclic Quadrilaterals, Radical Axis, Geometric Transformations)
  2. Coordinate Geometry (Distance Formula, Equations of Straight Lines, Equation of Circles)
  3. Conic Sections (Equations, Geometric Properties)
  4. Trigonometry (Basic properties of trigonometric functions, identities)
  
- Number Theory
  1. Divisibility
  2. Modular Congruences (Euler's Theorem, Fermat's Little Theorem, Wilson's Theorem, Chinese Remainder Theorem may be helpful.)
  3. Arithmetic Functions (Totient, Divisor, Sum of Divisors, Mobius Function)
  4. Diophantine Equations
  
- Set Theory
  1. Basics of Set Theory (Set union, intersection, symmetric difference)

2. Relations
3. Functions

- **Probability**

1. Basics of Probability (Conditional Probability, Bayes' Theorem, Binomial Trials, Expected Value)

## **Section B**

In addition to the syllabus of section A, the following topics -

- **Calculus**

1. Limits and Derivatives
2. Continuity and Differentiability
3. Applications of Derivatives
4. Integrals, Applications of Integrals
5. Differential Equations

- **Algebra**

1. Inverse Trigonometric Functions
2. Vector Algebra

- **Geometry**

1. Coordinate Geometry (Equations of Conic Sections)
2. Three Dimensional Geometry

- **Probability**

1. Normal Distribution
2. Basics of Linearity of Expectation

## Section C

- Advanced knowledge of all concepts mentioned in the high school syllabus
- **Linear Algebra**
  - Matrices
  - Linear Transformations
  - Eigenvalues and Eigenvectors
  - Diagonalization
  - Jordan Normal Form
  - Dual Spaces
  - Elementary knowledge of Forms (Bilinear Forms, Skew Symmetric Forms, etc.)
- **Calculus and Real Analysis**
  - Relations and Functions
  - Sequences and Series
  - Limits
  - Continuity
  - Uniform Continuity
  - Derivatives
  - Mean Value Theorem
  - L'Hopital's Rule
  - Taylor's Theorem
  - Riemann Integration
  - Fundamental Theorem of Calculus
  - Fubini's Theorem
  - Multivariable Calculus (Functions from  $\mathbb{R}^n \rightarrow \mathbb{R}^m$ , their derivatives, and inverse function theorem (not mandatory) might be useful.)
- **Abstract Algebra**

- Group Theory (Matrix Groups, Cauchy and Sylow Theorems, Cayley's Theorems, Permutations, Finite Abelian Groups (not mandatory), Isomorphism Theorems)
- Ring Theory (Basics)
- Field Theory (Basics)
  
- **Discrete Mathematics**
  - Advanced Combinatorial Concepts
  - Graph Theory
  
- **Probability Theory**
  - Probability Density Function
  - Probability Distribution Function (Bernoulli Distribution, Binomial Distribution, Poisson Distribution, Normal Distribution, Uniform Distribution, etc.)
  - Mean and Variance
  - Joint Probability Distribution