



SYLLABUS 2021

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1 Category A (Class 8 - 10)

1.1 Basic Arithmetic and Number Systems

- Some Standard Number Systems and Bases
- Primes and Powers
- Divisibility Tests and Applications
- Modular Arithmetic (basics)
- Rational, Irrational and Real Numbers
- Fundamental Theorem of Arithmetic, Infinitude of Primes
- Euclid's Algorithm, Bézout's Lemma and Applications

1.2 Geometry

- Euclid's Postulates
- Basic Properties of Circles
- Triangles and some Basic Formulae
- Trigonometry and Solutions of Triangle
- Special Circles and Centres of a Triangle
- Quadrilaterals and Higher Polygons
- Regular and Convex Polygons
- Area and Mensuration
- Properties of Shapes in 2D and 3D
- Congruence and Similarity

1.3 Algebra

- Factorisation and Simplification
- Polynomials (along with Vieta's Relations)
- Functional Equations
- Arithmetic and Geometric Progression
- Some basic Diophantine Equations Identities and Properties
- Some Special Sequences (Fibonacci, etc.)
- Inequalities (Square, AM-GM, Triangle)
- Basic Functions and their Applications

1.4 Basic Counting and Probability

- Law of Addition and Multiplication
- Combinations and Permutations
- Some Simple Counting Formulae
- Standard Situations
- Pigeonhole Principle
- Empirical Probability and Applications

1.5 Puzzle like Questions

2 Category B (Class 11 - 12)

2.1 Basic Arithmetic and Number Systems

- Some Standard Number Systems and Bases
- Divisibility and Modular Arithmetic
- Some well known Theorems (Euler, Fermat, Wilson)
- Diophantine Equations

2.2 Sets and Functions

- Set Theory
- Functions and Relations
- Functional Equations and Inequalities
- Graph Plotting and Applications
- Inverse Trigonometric Functions

2.3 Algebra

- Complex Numbers
- Polynomials
- Theory of Equations
- Sequences and Series
- Inequalities (Square, AM-GM, Cauchy Schwarz)
- Matrices and Determinants
- Binary Operators

2.4 Geometry

- Solutions of Triangles
- Circles
- Quadrilaterals and Higher Polygons
- Mensuration
- Application of Complex Numbers
- Co-ordinate Geometry upto 2 degree Curves (Conic and Straight Lines)
- Vectors and 3D Geometry

2.5 Combinatorics

- Basic Counting
- Combinations and Permutations
- Pigeonhole Principle and Extremal Combinatorics
- Invariance Principle
- Probability

2.6 Calculus

- Limit and Continuity
- Differentiation and Application of Derivatives
- Mean Value Theorem

2.7 Puzzle Like Questions

3 Category C (Undergraduates)

3.1 Full Category B Syllabus (excluding Coordinate Geometry and Pure Geometry)

3.2 Group Theory

- Cyclic, Matrix, Permutation, Dihedral Groups and other examples
- Subgroups and Lagrange's Theorem
- Quotient Groups and Normal Subgroups
- Group Homomorphisms
- Isomorphism Theorems
- Group Actions

3.3 Linear Algebra

- Matrices and Determinants
- Finite Dimensional Vector Spaces (Linear Independence, Bases, Dimensions, Direct Sums, Direct Products)
- Matrices of a Linear Transformation
- Matrix Similarity
- Eigenvectors
- Cayley-Hamilton Theorem
- Characteristic Polynomials

3.4 Rings and Fields

- Definitions and basic examples of Rings (with unity), Subrings and Ideals
- Polynomial Rings and adjunction of elements
- Gauss Lemma and other basic Theorems of Polynomial Rings
- Group Ring, Matrix Rings and Boolean Ring
- Units, Idempotents, Zero Divisors and Nilpotents
- Ring homomorphism (unital), Quotient Rings and Isomorphism Theorems
- Integral Domains, Prime and Irreducible elements

- Euclidean Domains, Principal Ideal Domains and Unique Factorization Domains
- Generated Ideals and Noetherian Rings
- Field of Fractions
- Fields and examples
- Field Extensions (Algebraic, Separable, Normal, etc.)
- Finite Fields

3.5 Analysis

- Sets and Functions
- Real Number System
- Sequences and Series
- Metric Spaces
- Continuity and Uniform Continuity
- Convex Functions
- Differentiation (Mean Value Theorem, Taylor's Theorem)
- Sequences and Series of Functions (Real and Complex)
- Power Series and Expansion of standard Functions
- Riemann Integral (over \mathbb{R}) and the Fundamental Theorem of Calculus
- Uniform Convergence and Stone–Weierstrass Approximation
- Multivariable Calculus: Sequences, Limits, Derivatives and Integration
- Implicit and Inverse Function Theorems
- Riemann Integral over generalized domain and Improper Integrals
- Curves and Surfaces in \mathbb{R}^2 and \mathbb{R}^3

3.6 Probability Theory

- Discrete Probability (Combinatorial)
- Random Variables and their Distributions (Discrete and Continuous)
- Conditional Probabilities and Expectation
- Chebyshev's Inequality and Weak Law of Large Numbers
- Joint Distributions and Densities
- Random Vectors and Their Transformations
- Characteristic Functions

3.7 Topology

- Standard Topologies – Trivial, Discrete, Order, Metric, K-Topology, Lower Bound, Cofinite, etc.
- Product and Box Topology
- Connected Sets, Paths Connectedness, Local Behaviours and Components (Quasi, General and Path)
- Compact Sets, Sequential and Limit Point Compactness, Locally Compact and One Point Compactness
- Separability Axioms (just the definition)

3.8 Discrete Math

- Quadratic Residues, Legendre Symbol, Law of Quadratic Reciprocity
- Introductory Graph Theory – Definition and examples
- Path, Cycles, Walks, Connected Graphs, Trees, etc.
- Degrees and Isomorphisms
- Eulerian and Hamiltonian Graphs
- Matching and Hall's Marriage Theorem
- Planar Graphs and Euler's Theorem
- Colouring and Ramsey's Theorem

3.9 Puzzle like Questions