JEE Advanced Syllabus 2025

Mathematics

Sets, Relations and Functions

- Sets:
  - Representations
  - Types (empty, finite, infinite)
  - Algebra of sets (union, intersection, complement, difference, symmetric difference)
  - De-Morgan's laws and practical problems
- Cartesian product, ordered pair
- Relations:
  - Domain and codomain
  - Equivalence relation
- Functions:
  - As a special case of relation, mappings
  - Domain, codomain, range
  - Invertible, even, and odd functions
  - Into, onto, and one-to-one functions
  - Special functions (polynomial, trigonometric, exponential, logarithmic, power, absolute value, greatest integer)
  - Sum, difference, product, and composition

Algebra

- Complex numbers:
  - Algebra (addition, multiplication, conjugation)
  - Polar representation
  - Properties of modulus and principal argument
  - Triangle inequality
  - Cube roots of unity, geometric interpretations
- Fundamental theorem of algebra (statement)
- Quadratic equations (real coefficients):
  - Relations between roots and coefficients
  - Formation with given roots
  - Symmetric functions of roots
- Progressions:
  - Arithmetic and geometric progressions
  - Arithmetic and geometric means
  - Sums of finite arithmetic and geometric progressions
  - Infinite geometric series

    - Sums of first *n* natural numbers, squares, and cubes
- Logarithms and properties
- Permutations and combinations
- Binomial theorem (positive integral index) and properties of binomial coefficients

Matrices

- Matrices as rectangular arrays
- Equality, addition, scalar multiplication, and product
- Transpose, elementary row and column transformations
- Determinant (up to order 3)
- Adjoint and inverse (up to order 3)
- Properties of matrix operations
- Diagonal, symmetric, and skew-symmetric matrices and properties
- Solutions of simultaneous linear equations (2 or 3 variables)

Probability and Statistics

- Probability:
    - Random experiment, sample space
    - Types of events (impossible, simple, compound)
    - Addition and multiplication rules
    - Conditional probability, independence
    - Total probability, Bayes Theorem
    - Computation using permutations and combinations
- Statistics:
    - Measures of central tendency and dispersion (mean, median, mode, mean deviation, standard deviation, variance)
    - Analysis of frequency distributions (same mean, different variance)
    - Random variable, mean, and variance

Trigonometry

- Trigonometric functions, periodicity, and graphs
- Addition and subtraction formulae
- Multiple and sub-multiple angles
- General solutions of trigonometric equations
- Inverse trigonometric functions (principal value) and properties

Analytical Geometry

- **Two Dimensions:**
    - Cartesian coordinates, distance between points, section formulae, shift of origin
    - Straight lines:
        - Various forms of equation
        - Angle between lines
        - Distance of a point from a line
        - Lines through intersection of two lines

        - Bisector of angle between two lines
        - Concurrency of lines
        - Centroid, orthocenter, incenter, circumcenter of a triangle
    - Circles:
        - Various forms of equation
        - Equations of tangent, normal, and chord
        - Parametric equations
        - Intersection with line or circle
        - Equation through intersection of two circles/circle and line
    - Conics (parabola, ellipse, hyperbola):
        - Standard form equations
        - Foci, directrices, eccentricity
        - Parametric equations
        - Equations of tangent and normal
    - Locus problems
- **Three Dimensions:**
    - Distance between points
    - Direction cosines and ratios
    - Equation of a line in space
    - Skew lines, shortest distance between two lines
    - Equation of a plane
    - Distance of a point from a plane
    - Angle between two lines/planes/line and plane
    - Coplanar lines

Differential Calculus

- Limits and continuity:
    - Limit of a function
    - Continuity of a function
    - Limit and continuity of sum, difference, product, quotient
    - L'Hospital rule
    - Continuity of composite functions
    - Intermediate value property
- Derivatives:
    - Derivative of a function
    - Sum, difference, product, quotient rules
    - Chain rule
    - Derivatives of polynomial, rational, trigonometric, inverse trigonometric, exponential, logarithmic functions
    - Tangents and normals
    - Increasing and decreasing functions
    - Second order derivatives
    - Maxima and minima

    - Rolle's and Lagrange's mean value theorems
    - Geometric interpretation
    - Derivatives of implicit functions
    - Geometric interpretation of derivatives

Integral Calculus

- Indefinite integrals of standard functions
- Definite integrals as limit of sums
- Properties of definite integrals
- Fundamental theorem of integral calculus
- Integration by parts, substitution, partial fractions
- Applications of definite integrals (areas)
- Differential equations:
    - Formation of ODEs
    - Homogeneous equations (first order, first degree)
    - Separation of variables
    - Linear first order equations

Vectors

- Addition, scalar multiplication
- Dot and cross products
- Scalar and vector triple products, geometrical interpretations