

JEE Advanced Mathematics Syllabus 2027

1. Sets, Relations and Functions

- Sets and their representations; empty, finite and infinite sets; algebra of sets; intersection, complement, difference and symmetric difference, and their algebraic properties.
- De Morgan's laws for union, intersection and difference (for a finite number of sets); practical problems based on set operations.
- Cartesian product of finite sets; ordered pairs; relations; domain and codomain of relations; equivalence relations.
- Functions as special cases of relations and as mappings; domain, codomain and range; invertible, even and odd functions; into, onto and one-to-one functions.
- Special functions, including polynomial, trigonometric, exponential, logarithmic, power, absolute-value and greatest-integer functions; sum, difference, product and composition of functions.

2. Algebra

- Algebra of complex numbers: addition, multiplication, conjugation and polar representation; properties of modulus and principal argument; triangle inequality; cube roots of unity and geometric interpretations.
- Statement of the Fundamental Theorem of Algebra; quadratic equations with real coefficients; relations between roots and coefficients; formation of quadratic equations with given roots; symmetric functions of roots.
- Arithmetic and geometric progressions; arithmetic and geometric means; sums of finite arithmetic and geometric progressions; infinite geometric series; sums of the first n natural numbers and of their squares and cubes.
- Logarithms and their properties; permutations and combinations; binomial theorem for a positive integral index; properties of binomial coefficients.

3. Matrices

- Matrices as rectangular arrays of real numbers; equality of matrices; addition, scalar multiplication and product of matrices; transpose; elementary row and column transformations.
- Determinants of square matrices of order up to three; adjoint and inverse of square matrices of order up to three; properties of matrix operations.
- Diagonal, symmetric and skew-symmetric matrices and their properties; solutions of simultaneous linear equations in two or three variables.

4. Probability and Statistics

- Random experiments and sample spaces; impossible, simple and compound events; addition and multiplication rules of probability; conditional probability; independence of events; total probability and Bayes' theorem.
- Computing probabilities using permutations and combinations.
- Measures of central tendency and dispersion: mean, median, mode, mean deviation, standard deviation and variance of grouped and ungrouped data.
- Frequency distributions with the same mean but different variance; random variables; mean and variance of a random variable.

5. Trigonometry

- Trigonometric functions, periodicity and graphs; addition and subtraction formulae; formulae involving multiple and sub-multiple angles; general solutions of trigonometric equations.
- Inverse trigonometric functions (principal values only) and their elementary properties.

6. Analytical Geometry

- **Two dimensions:** Cartesian coordinates; distance between two points; section formulae; shift of origin.
- Equations of a straight line in various forms; angle between two lines; distance of a point from a line; lines through the intersection of two given lines; angle bisectors; concurrency of lines.
- Centroid, orthocentre, incentre and circumcentre of a triangle.
- Circle equations in various forms; tangent, normal and chord; parametric equations; intersections of a circle with a line or another circle; equation of a circle through intersection points of two circles, or a circle and a line.
- Standard equations of parabolas, ellipses and hyperbolas; foci, directrices and eccentricity; parametric equations; tangents and normals.
- Locus problems.
- **Three dimensions:** distance between two points; direction cosines and direction ratios; equation of a straight line in space; skew lines and shortest distance between two lines.
- Equation of a plane; distance of a point from a plane; angles between two lines, two planes, and a line and a plane; coplanar lines.

7. Differential Calculus

- Limits of functions at real numbers; continuity; limits and continuity of sums, differences, products and quotients; L'Hospital's rule for evaluating limits.
- Continuity of composite functions; intermediate value property of continuous functions.
- Derivatives; derivatives of sums, differences, products and quotients; chain rule; derivatives of polynomial, rational, trigonometric, inverse trigonometric, exponential and logarithmic functions.
- Tangents and normals; increasing and decreasing functions; second-order derivatives; maximum and minimum values; Rolle's theorem and Lagrange's Mean Value Theorem, including geometric interpretations.
- Derivatives up to order two of implicit functions; geometric interpretation of derivatives.

8. Integral Calculus

- Integration as the inverse process of differentiation; indefinite integrals of standard functions; definite integrals as limits of sums; properties of definite integrals; Fundamental Theorem of Integral Calculus.
- Integration by parts, substitution and partial fractions; applications of definite integrals to areas bounded by simple curves.
- Formation of ordinary differential equations; solutions of homogeneous first-order, first-degree differential equations; separation of variables; linear first-order differential equations.

9. Vectors

- Addition of vectors and scalar multiplication; dot and cross products; scalar and vector triple products; geometric interpretations of these operations.