

[IIT-JEE MATHEMATICS]

JEE ADVANCED 2026

2026

COMPLETE *Syllabus*

CLASS 11 AND 12

MATHEMATICS

UNIT WISE

IN THIS SYLLABUS

PAPER	MATHEMATICS
UNITS	TWELVE
SCOPE	FULL JEE ADVANCED SYLLABUS
ALSO CARRIES	SYNTHESIS CARDS · STRATEGY
APPLIES TO	JEE ADVANCED 2026
PAIRED WITH	THE TWO YEAR COURSE PLANNER

[JEE ADVANCED]

How to read this syllabus

This is the Mathematics paper of JEE Advanced, set out unit by unit. It covers the same ground as JEE Main and then goes past it: the same topics are examined at greater depth, and several carry techniques Main never asks for.

Four units are marked HIGH WEIGHTAGE on their heading bar. That mark is a statement about how often the examination returns to them, not about how hard they are, and it is not permission to leave the others thin.

Between the units sit two kinds of card. A gold card carries the synthesis, the results and the cross-topic method that Advanced questions are built on. A dark card carries a single tip worth having in hand. The unit list above them is still the syllabus; the cards are how the syllabus is used.

Read this beside the course planner, which says when each unit is taught and which lectures cover it.

[UNIT-WISE STRATEGIC ROADMAP]

The Advanced syllabus *in full*

UNIT 01 Sets, Relations and Functions

- **Sets:** Representation and types; Algebra of sets (Union, Intersection, Difference); **Symmetric Difference**; Complement; De-Morgan's laws; **Power Sets**; Cartesian product of finite sets; Inclusion-Exclusion principle for 3 or more sets.
- **Relations:** Types of relations (Reflexive, Symmetric, Transitive); **Equivalence Relations** and Partitioning of sets; Number of possible relations; Inverse relations.
- **Functions as Mappings:** Definition; Domain, Co-domain, and Range; **Classification:** Injection (One-to-one), Surjection (Onto), Bijection (Both), and Into functions; Number of onto functions (using Inclusion-Exclusion).
- **Special Real-Valued Functions:** Polynomial, Rational, Trigonometric, Exponential, and Logarithmic; **Step Functions:** Greatest Integer $[x]$, Fractional Part $\{x\}$, Signum $\text{sgn}(x)$, and Modulus $|x|$ functions;

Algebra of functions.

- **Advanced Calculus of Functions:** Composition of functions (fog, gof); Invertible functions and their graphs; **Even and Odd functions**; Periodic functions and finding their fundamental periods; **Functional Equations** and their standard solutions.

PRO-TIP · THE BIJECTION & GRAPH STRATEGY

1. Symmetry in Graphs:

- If $f(x)$ is **even**, it is symmetric about the y -axis ($f(x) = f(-x)$).
- If $f(x)$ is **odd**, it is symmetric about the origin ($f(x) = -f(-x)$).
- The graph of $f^{-1}(x)$ is the reflection of $f(x)$ in the line $y = x$.

2. Calculus approach to Bijection: To prove a function is one-to-one (Injective) on a continuous interval, check its derivative $f'(x)$. If $f'(x) > 0$ or $f'(x) < 0$ strictly throughout the domain, the function is monotonic and therefore one-to-one.

UNIT 02 Algebra (Complex & Quadratic)

HIGH WEIGHTAGE

- **Complex Numbers:** Algebra of complex numbers; Addition, multiplication, and conjugation; Polar and Euler representation ($re^{i\theta}$); Properties of modulus and principal argument; **Triangle inequality** and its multi-variable generalizations.
- **Geometry in Argand Plane:** Representation of lines, circles, and conics in complex form; **Rotation theorem** (conic-method); Distance of a point from a line; **Complex Slope**; Dot and cross products in complex form.
- **Roots of Unity:** De Moivre's Theorem; n^{th} **roots of unity** and their geometric representation as vertices of a regular polygon; Sum and product of roots; **Cyclotomic polynomials** (introductory applications).
- **Quadratic Equations:** Fundamental Theorem of Algebra; Relations between roots and coefficients; **Nature of roots** (Real, imaginary, rational); Formation of equations with given roots; **Symmetric functions** of roots.
- **Advanced Quadratic Theory:** **Location of Roots** (Condition for roots lying in a specific interval); Common roots (one or both); **Newton's Sums** for finding $S_n = \alpha^n + \beta^n$; Maximum and minimum values of quadratic expressions; **Quadratic expressions in two variables**.

ADVANCED SYNTHESIS · GEOMETRY & NEWTON'S SUMS

1. The Locus Shortcut: In JEE Advanced, $|z - z_1| + |z - z_2| = k$ represents an ellipse if $k > |z_1 - z_2|$. If $k = |z_1 - z_2|$, it is the line segment joining z_1 and z_2 . Always check the constant k against the distance between foci first.

2. Newton's Sum Strategy: For the equation $ax^2 + bx + c = 0$, the sum of powers $S_n = \alpha^n + \beta^n$ follows the recurrence:

$$aS_n + bS_{n-1} + cS_{n-2} = 0$$

This is the fastest way to solve "integer-type" questions involving high powers of roots (e.g., $\alpha^{10} + \beta^{10}$).

UNIT 03 Matrices and Determinants

HIGH WEIGHTAGE

- **Matrix Fundamentals:** Types of matrices; **Symmetric and Skew-symmetric** matrices and their properties; Orthogonal matrices; Hermitian and Skew-Hermitian matrices (basic intro).
- **Determinants:** Evaluation of determinants (order ≤ 3); **Properties of determinants** (Scaling, Row-swapping, Linearity); Product of two determinants; Differentiation and Integration of determinants.
- **Adjoint and Inverse:** Definition and existence ($|A| \neq 0$); **Properties of Adjoint:** $\text{adj}(AB)$, $\text{adj}(kA)$, $\text{adj}(A^n)$, and $|\text{adj}(A)| = |A|^{n-1}$; Inverse of a product $(AB)^{-1} = B^{-1}A^{-1}$.
- **System of Linear Equations:** Consistency and Inconsistency; **Cramer's Rule**; Matrix Inverse method; Rank of a matrix; Number of solutions for **Homogeneous and Non-homogeneous** systems.
- **Advanced Matrix Theory:** Trace of a matrix; **Cayley-Hamilton Theorem** and its use in finding A^{-1} or A^n ; Special matrices: **Idempotent, Nilpotent, and Involutory** matrices.

ADVANCED SYNTHESIS · ADJOINT PROPERTIES & CAYLEY-HAMILTON

1. The Adjoint Power Law: One of the most frequent JEE Advanced patterns involves nested adjoints. Remember:

$$|\text{adj}(\text{adj}(A))| = |A|^{(n-1)^2} \quad \text{and} \quad \text{adj}(\text{adj}(A)) = |A|^{n-2}A$$

For a 3×3 matrix, these simplify to $|A|^4$ and $|A|A$ respectively.

2. Cayley-Hamilton Shortcut: If a question asks for A^{10} or A^{-1} , don't multiply manually. Use the characteristic equation $|A - \lambda I| = 0$. Replace λ with A to get a polynomial identity. *Example:* If $A^2 - 5A + 7I = 0$, then $A^{-1} = \frac{1}{7}(5I - A)$.

3. Determinant of Skew-Symmetric Matrices:

- If A is a skew-symmetric matrix of **odd order**, then $|A| = 0$ always.
- If A is of **even order**, $|A|$ is always a perfect square.

UNIT 04 Logarithms, P&C, and Binomial

- **Logarithms:** Definition and existence conditions; **Fundamental Logarithmic Identities;** Base-changing formula; Logarithmic equations and inequalities.
- **Permutations and Combinations:** Fundamental counting principle; **Linear and Circular Permutations;** Selection of objects; Grouping and Distribution into boxes.
- **Advanced Counting:** **Derangements** ($D_n = n! \sum \frac{(-1)^k}{k!}$); Principle of Inclusion-Exclusion (PIE); **Multinomial Theorem;** Grid-based path counting and Beggar's Method.
- **Binomial Theorem:** Expansion for integral index; General, **Middle**, and **Greatest** terms; **Binomial Theorem for any index;** Properties of nC_r and Identities.

ADVANCED SYNTHESIS · BINOMIAL CALCULUS & COMBINATORIAL IDENTITIES

1. The Calculus Triggers: When r appears in the coefficient of nC_r , transform the identity $(1+x)^n = \sum {}^nC_r x^r$:

- **Derivative Method:** If you see $r \cdot {}^nC_r$, differentiate once to get $n(1+x)^{n-1}$.
- **Integral Method:** If you see $\frac{{}^nC_r}{r+1}$, integrate from 0 to x to get $\frac{(1+x)^{n+1}-1}{n+1}$.

2. Double Summation Logic ($\sum_{i < j} C_i C_j$): Instead of manual expansion, use the "Square of Sum" symmetry:

$$\left(\sum_{i=0}^n C_i \right)^2 = \sum_{i=0}^n C_i^2 + 2 \sum_{0 \leq i < j \leq n} C_i C_j \implies (2^n)^2 = 2^n C_n + 2(\text{Required Sum})$$

3. Vandermonde's Identity Recognition: Whenever you encounter $\sum {}^nC_k \cdot {}^mC_{r-k}$ where the **lower indices sum to a constant** ($k+r-k=r$), the sum is simply choosing r objects from the combined pool: ${}^{n+m}C_r$.

UNIT 05 Sequence and Series

- **Progressions:** A.P., G.P., and H.P.; **Arithmetic, Geometric, and Harmonic Means;** Relationship: $A.M. \geq G.M. \geq H.M.$ and $G^2 = AH$.
- **Summation of Series:** Sum of n terms of A.P./G.P.; **Infinite Geometric Series;** Sums of squares and cubes of natural numbers.
- **Advanced Series:** **Arithmetico-Geometric Progression (A.G.P.);** **Method of Differences** (Telescopic Sums); **Sandwich Theorem** (Squeeze Theorem); Recurrence relations.

ADVANCED SYNTHESIS · THE TELESCOPIC STRATEGY ($V_n - V_{n-1}$)

1. The Method of Differences: If $T_r = f(r) - f(r-1)$, then $\sum_{r=1}^n T_r = f(n) - f(0)$.

• **Fractional Form:** $\frac{1}{r(r+1)} = \frac{1}{r} - \frac{1}{r+1}$.

• **Product Form:** $r(r+1) \dots (r+k) = \frac{r(r+1) \dots (r+k+1) - (r-1)r \dots (r+k)}{k+2}$.

2. Optimization via A.M. $\geq$ G.M.: For positive terms a_i , use $\frac{a_1 + \dots + a_n}{n} \geq (a_1 \dots a_n)^{1/n}$ to find minimum sums or maximum products.

UNIT 06 Trigonometry

- **Functions & Identities:** Periodicity; **Addition/subtraction formulae**; Double/triple angle formulae; Sum, difference, and product transformations.
- **Equations:** General solution of trig equations; **Inverse Trigonometric Functions (ITF):** Principal value branches; Graphs; ITF Properties.
- **Advanced Trigonometry:** Sum of sine/cosine series in A.P.; **Properties of Triangles (SOT):** Sine, Cosine, and Tangent rules; In-radius and Circum-radius.

ADVANCED SYNTHESIS · ITF GRAPHS & SERIES SUMMATION

1. The $f^{-1}(f(x))$ Trap: The graph of $y = \sin^{-1}(\sin x)$ is a periodic sawtooth. Reduce x to principal interval $[-\pi/2, \pi/2]$ before simplifying.

2. Summation of Sine/Cosine Series: For angles in A.P. ($\alpha, \alpha + \beta, \dots$):

$$\sum_{k=0}^{n-1} \sin(\alpha + k\beta) = \frac{\sin(n\beta/2)}{\sin(\beta/2)} \cdot \sin\left(\alpha + \frac{(n-1)\beta}{2}\right)$$

3. SOT Optimization: Use $r = 4R \sin(A/2) \sin(B/2) \sin(C/2)$ to link circum-radius to in-radius efficiently.

UNIT 07 Differential Calculus

HIGH WEIGHTAGE

- **Limits & Continuity:** Existence of limits via **Sandwich Theorem**; 1^∞ and 0^0 forms; Continuity vs. Uniform Continuity (introductory concepts); **Intermediate Value Theorem (IVT)** for root existence; Classification of discontinuities.
- **Differentiability:** Differentiability of $|f(x)|$ and $\max / \min\{f(x), g(x)\}$; **Darboux's Theorem** (Intermediate value property of derivatives); Differentiability of functions defined by functional equations and integrals.
- **Advanced Differentiation:** **Leibniz Rule** for differentiating under the integral sign; Successive differentiation and **General Leibniz Formula** for $(uv)^{(n)}$; Differentiation of inverse functions and determinants.

- **Mean Value Theorems:** Rolle's Theorem; Lagrange's Mean Value Theorem (LMVT); **Cauchy's Mean Value Theorem;** Applications in proving complex inequalities and establishing bounds for functions.
- **Applications of Derivatives (AOD): Monotonicity:** Critical points; Points of non-differentiability as potential extrema. **Curvature:** Concavity; **Points of Inflection** (The sign-change condition of $f''(x)$). **Geometry:** Tangents/Normals; Angle of intersection; Sub-tangent and sub-normal lengths.

ADVANCED SYNTHESIS · THE CALCULUS ANALYST'S TOOLKIT

- 1. The IVT & Root Counting:** If $f(x)$ is continuous on $[a, b]$ and $f(a) \cdot f(b) < 0$, there exists **at least one** root. To prove **uniqueness**, show $f'(x)$ is strictly monotonic (never zero) in (a, b) .
- 2. The Leibniz Trigger (Fundamental):** For $\frac{d}{dx} \int_{g(x)}^{h(x)} f(t) dt$, the result is $f(h(x))h'(x) - f(g(x))g'(x)$. Use this to convert integral equations into differential equations in "Paragraph" questions.
- 3. Product Differentiability Shortcut:** For $h(x) = f(x) \cdot g(x)$, if $f(a) = 0$ and $g(x)$ is non-differentiable at a : $h(x)$ is differentiable at $x = a$ **if and only if** $f(a) = 0$. For $h(x)$ to be **twice** differentiable, we require $f(a) = f'(a) = 0$.
- 4. Rolle's, LMVT & Helper Functions:** If $f(x)$ has n roots, $f'(x)$ has at least $n - 1$ roots. To analyze roots of $f'(x) + kf(x) = 0$, construct $h(x) = e^{kx}f(x)$. If analyzing $xf'(x) + nf(x) = 0$, use $h(x) = x^n f(x)$.
- 5. Concavity & Jensen's Inequality:** If $f''(x) > 0$ (convex) on $[a, b]$, then $f\left(\frac{x_1+x_2}{2}\right) \leq \frac{f(x_1)+f(x_2)}{2}$. This is the ultimate tool for proving functional inequalities without explicit integration.
- 6. Differentiability of $|f(x)|$:** $|f(x)|$ is non-differentiable at points where $f(x) = 0$, **unless** those points are also stationary points ($f'(x) = 0$). This is vital for "Number of points of non-differentiability" questions.

UNIT 08 **Integral Calculus**

HIGH WEIGHTAGE

- **Indefinite Integration:** Standard integrals; Integration by substitution; **Integration by parts** (ILATE rule and repeated integration); Integration by partial fractions; **Reduction formulae** for $\int \sin^n x dx$ and $\int \tan^n x dx$.
- **Definite Integrals:** Fundamental Theorem of Calculus (Part 1 and 2); **Properties of Definite Integrals:** King's Property ($a + b - x$), Queen's Property, and Piecewise integration for $|f(x)|$, $[x]$, and $\{x\}$.
- **Special Techniques:** Wallis' Formula for $\int_0^{\pi/2} \sin^m x \cos^n x dx$; Integration as the **Limit of a Sum**; **Leibniz Rule** (revisited for integral evaluation); Differentiation and integration under the integral sign.
- **Estimation & Convergence:** **Estimation of Definite Integrals** using monotonicity ($m(b-a) \leq \int_a^b f(x) dx$, $\int_a^b f(x) dx \leq M(b-a)$); Comparison of integrals; Improper integrals and their convergence (Basic concepts).
- **Area Bounded by Curves:** Computation of area using horizontal and vertical strips; **Area between two curves**; Symmetrical areas; Areas involving inverse functions and parametric curves.

ADVANCED SYNTHESIS · INTEGRAL ESTIMATION

1. The King's Property ($a + b - x$): If $f(x) + f(a + b - x) = C$, then $\int_a^b f(x) dx = \frac{C(b-a)}{2}$. This is the "Symmetry Shortcut" for complex transcendental integrands.

2. Wallis' Shortcut: For $I = \int_0^{\pi/2} \sin^n x dx$ (or $\cos^n x$):

$$I = \frac{(n-1)(n-3)\dots(1 \text{ or } 2)}{n(n-2)\dots(1 \text{ or } 2)} \cdot K$$

Where $K = \pi/2$ if n is even, and $K = 1$ if n is odd.

3. Integral Estimation: If $f(x) \leq g(x)$ on $[a, b]$, then $\int_a^b f(x) dx \leq \int_a^b g(x) dx$. *Crucial for 2026:* Use the Taylor-based inequality $x - \frac{x^3}{6} < \sin x < x$ to bound trigonometric integrals.

4. Integration as the Limit of a Sum: To evaluate $\lim_{n \rightarrow \infty} \sum_{r=1}^n \frac{1}{n} f\left(\frac{r}{n}\right)$, transform the sum into a definite integral using these mappings:

- Replace $\frac{r}{n}$ with x and $\frac{1}{n}$ with dx .
- The summation $\sum$ becomes the integral $\int$.
- **Limits:** Lower limit is $\lim_{n \rightarrow \infty} \frac{r_{\min}}{n}$ and Upper limit is $\lim_{n \rightarrow \infty} \frac{r_{\max}}{n}$.

For a standard $\sum_{r=1}^n$, the integral limits are simply 0 to 1.

UNIT 09 Differential Equations

HIGH WEIGHTAGE

- **Fundamentals:** Order and degree of a differential equation; **Formation of DE** by elimination of arbitrary constants; Geometric interpretation of DE.
- **First Order & First Degree Equations: Variable Separable Method:** Standard form and equations reducible to variable separable by substitution. **Homogeneous Equations:** Definition of homogeneous functions; Substitution $y = vx$; Equations reducible to homogeneous form. **Linear Differential Equations (LDE):** Standard form $\frac{dy}{dx} + Py = Q$; **Integrating Factor (I.F.)** $e^{\int P dx}$; Bernoulli's equation (Reducible to LDE).
- **Exact Differential Equations:** Recognition of exact forms; **Integrating by Inspection** using standard differentials ($d(xy)$, $d(y/x)$, $d(\ln(xy))$, etc.).
- **Orthogonal Trajectories:** Definition and method to find orthogonal trajectories in Cartesian coordinates.
- **Applications:** Growth and decay models; **Newton's Law of Cooling**; Population dynamics; Geometric problems involving tangents and normals.

ADVANCED SYNTHESIS · INTEGRATING BY INSPECTION & LDE STRATEGY

1. The “Exact” Shortcut: If you see expressions like $x dy + y dx$, recognize them as $d(xy)$ immediately. This bypasses the need for long-form integration.

- $x dy - y dx$ with x^2 in the denominator is $d(y/x)$.
- $\frac{x dy + y dx}{xy}$ is $d(\ln(xy))$.

2. Bernoulli’s Transformation: For equations of the form $\frac{dy}{dx} + Py = Qy^n$, always divide by y^n and substitute $v = y^{1-n}$. This is a frequent “Paper 2” multi-correct trap.

3. Integral-to-DE Conversion: If a problem states $f(x) = x + \int_0^x f(t) dt$, differentiate both sides using the **Leibniz Rule** to form the DE: $f'(x) = 1 + f(x)$. This is the most consistent way JEE Advanced tests Unit 9.

UNIT 10 Analytical Geometry (2D)

HIGH WEIGHTAGE

- **Straight Lines:** Various forms of equations; **Distance between parallel lines**; Position of points relative to a line; **Angle bisectors** (Acute/Obtuse and Origin-containing); Family of lines passing through the intersection of two lines.
- **Circles:** Standard and general equations; **Tangent and Normal** to a circle; Condition of tangency; **Power of a point**; Radical axis and Radical centre; Family of circles; **Orthogonality of two circles**.

CONIC SECTIONS: PARABOLA, ELLIPSE AND HYPERBOLA

- **Standard Properties:** Foci, directrices, eccentricity, and latus rectum; **Parametric coordinates** and their advantages in locus problems.
- **Tangents & Normals:** Equations in slope, point, and parametric forms; **Condition of tangency** ($c = a/m$ for parabola, etc.); Point of contact; **Common tangents** between two different conics.
- **Chords:** Chord of contact; **Chord with a given midpoint** ($T = S_1$); Pole and Polar properties.
- **Advanced Concepts:** **Director Circle** and its significance; Auxiliary circles; **Asymptotes of a Hyperbola** and Rectangular hyperbola ($xy = c^2$); Reflector properties of conics.

ADVANCED SYNTHESIS · THE UNIVERSAL CONIC STRATEGY

1. The Parametric Shortcut: When solving “Locus” problems involving a moving point on a conic, always start with parametric coordinates ($(at^2, 2at)$ for Parabola, $(a \cos \theta, b \sin \theta)$ for Ellipse). This reduces the number of variables and simplifies the elimination process.

2. Condition of Tangency (Common Tangents): To find a common tangent between two conics (e.g., a circle and a parabola), write the general slope form tangent for both: *Circle:* $y = mx \pm a\sqrt{1+m^2}$ *Parabola:* $y = mx + a/m$ Equate the constants to solve for m . This is the most consistent “Paper 1” geometry pattern.

3. Director Circle & Orthogonality: The locus of the point of intersection of **perpendicular tangents** is the Director Circle.

- *Circle* ($x^2 + y^2 = r^2$): $x^2 + y^2 = 2r^2$.
- *Ellipse:* $x^2 + y^2 = a^2 + b^2$.
- *Parabola:* The **Directrix** ($x = -a$).

UNIT 11 Vectors and 3D Geometry

HIGH WEIGHTAGE

- **Vector Algebra:** Addition and scalar multiplication; **Dot and Cross products;** Scalar and Vector Triple products ($[a, b, c]$ and $a \times (b \times c)$); **Geometric interpretation** of products (Area of parallelogram, Volume of parallelepiped/tetrahedron).
- **Linear Independence:** Linear combination of vectors; **Linearly independent and dependent** vectors; Coplanar and Non-coplanar vectors; Collinearity of three points.
- **Lines in 3D:** Cartesian and Vector equations of a line; **Angle between two lines;** Direction cosines and direction ratios; **Skew lines** and the condition for intersection; Shortest distance between two lines.
- **Planes in 3D:** Equation of a plane in various forms (Normal, Three-point, Intercept); **Angle between two planes;** Distance of a point from a plane; **Line of intersection** of two planes; Plane containing two lines.
- **Line and Plane Interaction:** **Angle between a line and a plane;** Intersection of a line and a plane; **Image of a point** in a plane and a line; Foot of the perpendicular.

ADVANCED SYNTHESIS · VECTOR TRIPLE PRODUCTS & SKEW LINES

1. The VTP “Back-Cab” Rule: For $a \times (b \times c)$, always use the identity $b(a \cdot c) - c(a \cdot b)$. *Strategic Note:* This vector always lies in the plane of b and c , and is perpendicular to a . Use this for “Directional” vector problems in Paper 2.

2. Shortest Distance (S.D.) Logic: For two lines $\vec{r} = \vec{a}_1 + \lambda \vec{b}_1$ and $\vec{r} = \vec{a}_2 + \mu \vec{b}_2$:

$$S.D. = \frac{|(\vec{a}_2 - \vec{a}_1) \cdot (\vec{b}_1 \times \vec{b}_2)|}{|\vec{b}_1 \times \vec{b}_2|}$$

If the numerator is zero, the lines are **Coplanar** (either intersecting or parallel).

3. Volume of a Tetrahedron: The volume of a tetrahedron with vertices A, B, C, D is $\frac{1}{6} |[\vec{AB}, \vec{AC}, \vec{AD}]|$. This is a frequent “Integer Type” question starter involving the Scalar Triple Product.

UNIT 12 Probability and Statistics

HIGH WEIGHTAGE

- **Basic Probability:** Random experiments and sample spaces; **Events:** Simple, compound, and mutually exclusive; Axiomatic approach to probability; Addition and multiplication rules.
- **Conditional Probability:** Definition and properties; **Independent Events** and their conditions; Theorem of Total Probability; **Bayes’ Theorem** and its applications in inverse probability problems.
- **Random Variables:** Discrete and continuous random variables; **Probability Distribution Function (PDF);** Expectation (Mean) and Variance of a random variable; **Binomial Distribution** and its properties (Mean np and Variance npq).
- **Bernoulli Trials:** Success and failure trials; **Binomial Trials** with n independent experiments; Poisson Distribution (introductory properties for high-difficulty limits).
- **Statistics:** Measures of central tendency; **Measures of Dispersion:** Range, Mean Deviation, and Quartile Deviation; **Variance and Standard Deviation** for grouped and ungrouped data; Coefficient of Variation.

ADVANCED SYNTHESIS · P&C CROSS-OVER & INCLUSION-EXCLUSION

The Tree Diagram Strategy: For complex Bayes' problems, construct a tree where the first branches represent the partition of the sample space $(E_1, E_2, \dots, E_n)$. The second level branches represent the conditional probability $P(A|E_i)$.

- **Total Probability:** The sum of the products along the paths leading to event A .
- **Bayes' Numerator:** The product along the specific path $(E_i \rightarrow A)$ you are analyzing.

1. Combinatorial Probability: In JEE Advanced, the sample space is rarely given. Use $n(S) = {}^nC_r$ or $n!$ based on the Unit 4 counting principles.

2. Inclusion-Exclusion (PIE): For "Probability of at least one" among three events (A, B, C) :

$$P(A \cup B \cup C) = \sum P(A) - \sum P(A \cap B) + P(A \cap B \cap C)$$

3. Geometric Probability: If an event is defined by a region in a 2D plane (e.g., choosing a point (x, y)), the probability is $\frac{\text{Area of Favorable Region}}{\text{Total Area}}$. Use this for "Inequality-based" probability questions.

OFFICIAL ACADEMIC RELEASE

REF IITF-2026-ELITE-ROADMAP

STATUS DETAILED SYLLABUS

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