

# All formula of first year engineering maths

**All formula of first year engineering maths** Understanding the fundamental mathematical formulas is essential for first-year engineering students. These formulas serve as the backbone for solving complex engineering problems and form the foundation for advanced topics. In this comprehensive guide, we will cover all the vital formulas in first-year engineering mathematics, categorized for easy reference and better understanding.

## 1. Algebra and Polynomial Equations

### 1.1 Basic Algebraic Identities

-  $(a + b)^2 = a^2 + 2ab + b^2$  -  $(a - b)^2 = a^2 - 2ab + b^2$  -  $a^2 - b^2 = (a + b)(a - b)$  -  $(a + b)(a - b) = a^2 - b^2$  -  $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

### 1.2 Polynomial Equations

- Quadratic Equation:  $ax^2 + bx + c = 0$  - Roots:  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$  - Sum of roots:  $\alpha + \beta = -\frac{b}{a}$  - Product of roots:  $\alpha \beta = \frac{c}{a}$

## 2. Trigonometry

### 2.1 Basic Trigonometric Ratios

-  $\sin \theta = \frac{\text{Opposite}}{\text{Hypotenuse}}$  -  $\cos \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}}$  -  $\tan \theta = \frac{\text{Opposite}}{\text{Adjacent}}$

### 2.2 Trigonometric Identities

-  $\sin^2 \theta + \cos^2 \theta = 1$  -  $1 + \tan^2 \theta = \sec^2 \theta$  -  $1 + \cot^2 \theta = \csc^2 \theta$  -  $\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$  -  $\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$

### 2.3 Key Formulas

- Law of Sines:  $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$  - Law of Cosines:  $c^2 = a^2 + b^2 - 2ab \cos C$

## 3. Coordinate Geometry

### 3.1 Distance Formula

- Distance between points  $(x_1, y_1)$  and  $(x_2, y_2)$ :  $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

### 3.2 Midpoint Formula

- Midpoint between two points:  $M = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

### 3.3 Equation of a Line

- Slope-intercept form:  $y = mx + c$  - Point-slope form:  $y - y_1 = m(x - x_1)$  - Two-point form:  $y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$

### 3.4 Area of a Triangle

- Using vertices  $(x_1, y_1), (x_2, y_2), (x_3, y_3)$ :  $\text{Area} = \frac{1}{2} |x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$

## 4. Calculus

### 4.1 Differentiation

- Power rule:  $\frac{d}{dx} x^n = nx^{n-1}$  - Sum rule:  $\frac{d}{dx} [f(x) + g(x)] = f'(x) + g'(x)$  - Product rule:  $\frac{d}{dx} [f(x)g(x)] = f'(x)g(x) + f(x)g'(x)$  - Quotient rule:  $\frac{d}{dx} \left[ \frac{f(x)}{g(x)} \right] = \frac{f'(x)g(x) - f(x)g'(x)}{g^2(x)}$  - Chain rule:  $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$

### 4.2 Integration

- Basic formulas:  $\int x^n dx = \frac{x^{n+1}}{n+1} + C$ ,  $n \neq -1$  -  $\int e^x dx = e^x + C$  -  $\int \frac{1}{x} dx = \ln |x| + C$  - Standard integrals:  $\int \sin x dx = -\cos x + C$  -  $\int \cos x dx = \sin x + C$  -  $\int \sec^2 x dx = \tan x + C$  -  $\int \csc^2 x dx = -\cot x + C$

## 5. Differential Equations

### 5.1 Basic Types and Formulas

- First Order Linear Differential Equation:  $\frac{dy}{dx} + Py = Q$  - Solution:  $y = e^{-\int P dx} \left( \int Q e^{\int P dx} dx + C \right)$  - Separable Differential Equation:  $\frac{dy}{dx} = g(x)h(y)$  - Solution:  $\int \frac{1}{h(y)} dy = \int g(x) dx + C$

## 6. Matrices and Determinants

### 6.1 Basic Formulas

- Matrix Addition:  $(A + B)$  - Matrix Multiplication:  $(AB)$  - Determinant of 2x2 matrix:  $\det \begin{bmatrix} a & b \\ c & d \end{bmatrix} = ad - bc$  - Inverse of 2x2 matrix:  $A^{-1} = \frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$

## 7. Probability and Statistics

### 7.1 Basic Formulas

- Mean:  $\bar{x} = \frac{\sum x_i}{n}$  - Variance:  $\sigma^2 = \frac{\sum (x_i - \bar{x})^2}{n}$  - Standard Deviation:  $\sigma = \sqrt{\sigma^2}$  - Binomial Probability:  $P(k) = \binom{n}{k} p^k (1-p)^{n-k}$

## 8. Complex Numbers

### 8.1 Basic Formulas

-  $i^2 = -1$  - Modulus:  $|z| = \sqrt{x^2 + y^2}$  - Argument:  $\theta = \tan^{-1} \frac{y}{x}$  - Polar form:  $z = r(\cos \theta + i \sin \theta)$

## 9. Vector Algebra

### 9.1 Basic Operations

- Vector addition and subtraction - Dot product:  $\mathbf{A} \cdot \mathbf{B} = |\mathbf{A}| |\mathbf{B}| \cos \theta$  - Cross product:  $\mathbf{A} \times \mathbf{B} = |\mathbf{A}| |\mathbf{B}| \sin \theta \mathbf{n}$  - where  $\theta$  is the angle between vectors, and  $\mathbf{n}$  is the unit

First Year Engineering Maths Formulas are the foundational tools that every engineering student must master to excel in their academic pursuits. These formulas not only serve as shortcuts for solving complex problems but also deepen understanding of core mathematical concepts essential for advanced engineering topics. This comprehensive review aims to systematically present all crucial formulas encountered in the first-year engineering mathematics curriculum, breaking them down into digestible sections with detailed explanations, applications, and critical insights.

## 1. Algebra and Polynomial Equations

Algebra forms the backbone of mathematical problem-solving in engineering. The key formulas involve identities, factorization, and equations.

## 1.1 Basic Algebraic Identities

-  $((a + b)^2 = a^2 + 2ab + b^2)$  -  $((a - b)^2 = a^2 - 2ab + b^2)$  -  $(a^2 - b^2 = (a + b)(a - b))$   
-  $(a^3 + b^3 = (a + b)(a^2 - ab + b^2))$  -  $(a^3 - b^3 = (a - b)(a^2 + ab + b^2))$  Features: - Simplify algebraic expressions. - Factor higher-order polynomials. Pros: - Quick factorization. - Useful in solving equations. Cons: - Limited to binomials and simple identities.

## 1.2 Polynomial Roots and Factorization

- Polynomial of degree  $(n)$ :  $(P(x) = a_n x^n + a_{n-1} x^{n-1} + \dots + a_0)$  - Rational Root Theorem: Possible roots are factors of  $(a_0)$  over factors of  $(a_n)$ . Formulas for solving polynomial equations: - Quadratic:  $(ax^2 + bx + c = 0)$  - Roots:  $(x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a})$  Features: - Roots of quadratic equations. - Factorization techniques. Pros: - Straightforward for quadratics. - Foundation for higher-degree polynomial solving. Cons: - Complexity increases with degree.

## 2. Trigonometry

Trigonometry deals with angles and their relationships, essential in waveforms, oscillations, and geometry.

### 2.1 Basic Trigonometric Ratios

-  $(\sin \theta = \frac{\text{Opposite}}{\text{Hypotenuse}})$  -  $(\cos \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}})$  -  $(\tan \theta = \frac{\text{Opposite}}{\text{Adjacent}})$  Key identities: -  $(\sin^2 \theta + \cos^2 \theta = 1)$  -  $(\tan \theta = \frac{\sin \theta}{\cos \theta})$

### 2.2 Trigonometric Identities

- Sum and difference: -  $(\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B)$  -  $(\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B)$  - Double angle: -  $(\sin 2A = 2 \sin A \cos A)$  -  $(\cos 2A = \cos^2 A - \sin^2 A)$  - Power reduction: -  $(\sin^2 A = \frac{1 - \cos 2A}{2})$  -  $(\cos^2 A = \frac{1 + \cos 2A}{2})$  Features: - Simplify trig expressions. - Solve equations involving angles. Pros: - Widely applicable in wave and oscillation problems. Cons: - Memorization-intensive.

## 3. Logarithms and Exponentials

Logarithmic and exponential functions are crucial for understanding growth, decay, and scale transformations.

### 3.1 Logarithm Properties

-  $(\log_b(xy) = \log_b x + \log_b y)$  -  $(\log_b \frac{x}{y} = \log_b x - \log_b y)$  -  $(\log_b x^k = k \log_b x)$

$\log_b x$ ) - Change of base:  $\log_b x = \frac{\log_a x}{\log_a b}$

## 3.2 Exponential Laws

-  $a^m \times a^n = a^{m+n}$  -  $\frac{a^m}{a^n} = a^{m-n}$  -  $(a^m)^n = a^{mn}$  -  $a^0 = 1$   
Features: - Simplify exponential and logarithmic expressions. - Solve exponential equations. Pros: - Models exponential growth/decay. Cons: - Requires understanding of bases.

## 4. Calculus

Calculus forms the core for analyzing changing quantities, optimization, and motion.

### 4.1 Limits and Continuity

-  $\lim_{x \rightarrow a} f(x) = L$  - Limit laws:  $\lim_{x \rightarrow a} [f(x) + g(x)] = \lim_{x \rightarrow a} f(x) + \lim_{x \rightarrow a} g(x)$

### 4.2 Differentiation Formulas

- Power rule:  $\frac{d}{dx} x^n = n x^{n-1}$  - Constant multiple:  $\frac{d}{dx} [k f(x)] = k f'(x)$  - Sum rule:  $\frac{d}{dx} [f(x) + g(x)] = f'(x) + g'(x)$  - Product rule:  $\frac{d}{dx} [f(x)g(x)] = f'(x)g(x) + f(x)g'(x)$  - Quotient rule:  $\frac{d}{dx} \left[ \frac{f(x)}{g(x)} \right] = \frac{f'(x)g(x) - f(x)g'(x)}{g(x)^2}$  - Chain rule:  $\frac{d}{dx} f(g(x)) = f'(g(x))g'(x)$

### 4.3 Integration Formulas

- Power rule:  $\int x^n dx = \frac{x^{n+1}}{n+1} + C$  ( $n \neq -1$ ) - Exponential:  $\int e^{ax} dx = \frac{1}{a} e^{ax} + C$  - Basic integrals:  $\int \frac{1}{x} dx = \ln |x| + C$   
Features: - Find slopes and areas under curves. - Analyze dynamic systems. Pros: - Essential for physics and engineering analysis. Cons: - Requires practice to master rules.

## 5. Coordinate Geometry

Understanding geometric relationships in the coordinate plane is vital in engineering graphics and spatial analysis.

### 5.1 Straight Lines

- Equation in slope-intercept form:  $y = mx + c$  - Point-slope form:  $y - y_1 = m(x - x_1)$  - Slope of two points:  $m = \frac{y_2 - y_1}{x_2 - x_1}$  - Distance between two points:  $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$  - Midpoint:  $\left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

## 5.2 Circles and Conic Sections

- Circle:  $((x - h)^2 + (y - k)^2 = r^2)$  Features: - Equation derivation. - Graphical interpretation.  
Pros: - Critical in CAD and mechanical design. Cons: - Geometric intuition required.

## 6. Differential Equations

Differential equations relate functions with their derivatives, modeling real-world phenomena like heat transfer, vibrations, etc.

### 6.1 Basic Differential Equations

- First order linear:  $(\frac{dy}{dx} + p(x)y = q(x))$  - Homogeneous equations:  $(\frac{dy}{dx} = f(y/x))$

### 6.2 Solutions

- Integrating factor method: - For  $(\frac{dy}{dx} + p(x)y = q(x))$ , - Integrating factor:  $(\mu(x) = e^{\int p(x) dx})$  - General solution:  $(y \cdot \mu(x) = \int q(x) \mu(x) dx)$

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## Questions & Answers About all formula of first year engineering maths

| No | Question                                                                                | Answer                                                                                                                                                                                                                           |
|----|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | What are the basic formulas for differentiation in first-year engineering mathematics?  | The basic differentiation formulas include: $\frac{d}{dx} [x^n] = nx^{n-1}$ , $\frac{d}{dx} [e^x] = e^x$ , $\frac{d}{dx} [\sin x] = \cos x$ , $\frac{d}{dx} [\cos x] = -\sin x$ , and the constant rule $\frac{d}{dx} [c] = 0$ . |
| 2  | How is the integration of standard functions performed in first-year engineering maths? | Key integration formulas include: $\int x^n dx = \frac{x^{n+1}}{n+1} + C$ (for $n \neq -1$ ), $\int e^x dx = e^x + C$ , $\int \sin x dx = -\cos x + C$ , and $\int \cos x dx = \sin x + C$ .                                     |

|   |                                                                                                               |                                                                                                                                                                                                                                          |
|---|---------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | What are the common formulas for solving linear differential equations in first-year engineering mathematics? | For first-order linear differential equations of the form $dy/dx + Py = Q$ , the integrating factor is $\mu(x) = e^{\int P dx}$ . The solution is $y(x) = (1/\mu(x)) \int \mu(x)Q dx + C$ .                                              |
| 4 | What are the standard formulas for vector calculus in first-year engineering maths?                           | Key vector calculus formulas include: Gradient of $f$ , $\nabla f$ ; Divergence, $\text{div } F = \nabla \cdot F$ ; Curl, $\text{curl } F = \nabla \times F$ ; and the Laplacian, $\Delta f = \text{div}(\text{grad } f) = \nabla^2 f$ . |
| 5 | What are the basic formulas for sequences and series in first-year engineering mathematics?                   | Important formulas include the sum of an arithmetic series: $S_n = n/2 (\text{first term} + \text{last term})$ , and for geometric series: $S_n = a(1 - r^n)/(1 - r)$ , $r \neq 1$ .                                                     |
| 6 | How are multiple integrals (double and triple integrals) formulated in first-year engineering maths?          | Double integrals are written as $\iint_D f(x, y) dx dy$ over a region $D$ , and triple integrals as $\iiint_V f(x, y, z) dx dy dz$ over volume $V$ , used to compute areas, volumes, and mass.                                           |

first year engineering maths formulas, calculus formulas engineering, algebra formulas engineering, differential equations formulas, matrices formulas engineering, vectors formulas engineering, complex numbers formulas, integral calculus formulas, limits and continuity formulas, trigonometry formulas engineering

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