

Topic(s) :

Chapter 3: Integration by parts (खण्डशः समाकलन)

(1) $\int u v dx$

Where u and v are function of x

(u और v x के फलन हैं)

(2) ILATE Rule

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$$\int u v dx = u \int v dx - \int \left\{ \frac{du}{dx} \cdot \int v dx \right\} dx$$



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$$\int u v dx = u \int v dx - \int \left\{ \frac{du}{dx} \cdot \int v dx \right\} dx$$

Q. $\int x \cos x dx = x \int \cos x dx - \int \left\{ \frac{dx}{dx} \cdot \int \cos x dx \right\} dx$

$$= x \sin x - \int \left\{ 1 \cdot \sin x \right\} dx$$

$$= x \sin x - \int \sin x dx$$

$$= x \sin x - (-\cos x) + C$$

$$\int x \cos x dx = x \sin x + \cos x + C \quad \text{Ans}$$



$$\int u v dx = u \int v dx - \int \left\{ \frac{du}{dx} \cdot \int v dx \right\} dx$$

Q.

$$\int x e^x dx = x \int e^x dx - \int \left\{ \frac{dx}{dx} \cdot \int e^x dx \right\} dx$$

$$= x e^x - \int \left\{ 1 \cdot e^x \right\} dx$$

$$= x e^x - \int e^x dx$$

$$= x e^x - e^x + C$$

$$\int x e^x dx = e^x (x - 1) + C \quad \text{Ans}$$

But

$$x e^x = e^x x$$

$$2 \times 3 = 3 \times 2$$

$$\int e^x x dx = ?$$

$$\int u v dx = u \int v dx - \int \left\{ \frac{du}{dx} \cdot \int v dx \right\} dx$$

Q.

$$\int e^x x dx = e^x \int x dx - \int \left\{ \frac{de^x}{dx} \cdot \int x dx \right\} dx$$

$$= e^x \frac{x^2}{2} - \int e^x \frac{x^2}{2} dx$$

$$= e^x \frac{x^2}{2} - \frac{1}{2} \int e^x x^2 dx$$

$$= e^x \frac{x^2}{2} - \frac{1}{2} \left[e^x \int x^2 dx - \int \left\{ \frac{de^x}{dx} \cdot \int x^2 dx \right\} dx \right]$$

$$= e^x \frac{x^2}{2} - \frac{1}{2} \left[e^x \frac{x^3}{3} - \int \left\{ e^x \cdot \frac{x^3}{3} \right\} dx \right]$$

$$\int e^x x dx = e^x \frac{x^2}{2} - \frac{1}{2} e^x \frac{x^3}{3} - \frac{1}{6} \int \left\{ e^x \cdot x^3 \right\} dx$$

ILATE Rule

Inverse trigonometric function (प्रतीलोम त्रिकोणमितीय फलन) $\sin^{-1}x$, $\cos^{-1}x$, $\tan^{-1}x$ ---

Logarithmic function (लघुगुणकीय फलन) $\log x$, ---

Algebraic function (बीजीय फलन) x^2 , x , $x^0=1$, $3x+5$, ---

Trigonometric function (त्रिकोणमितीय फलन) $\sin x$, $\cos x$, $\tan x$, ---

Exponential function (चरघातांकीय फलन) e^x , a^x , ---

I L A T E Rule



Choice of first and second function (प्रथम एवं द्वितीय फलन का चयन)

$$(1) \int x \tan^{-1} x \, dx = \int \tan^{-1} x \cdot x \, dx$$

\downarrow \downarrow
A I

$$(2) \int x e^x \, dx$$

\downarrow \downarrow
A E

$$(3) \int x \log x \, dx = \int \log x \cdot x \, dx$$

\downarrow \downarrow
A L

$$\int u \cdot v \, dx = u \int v \, dx - \int \left\{ \frac{du}{dx} \cdot \int v \, dx \right\} dx$$

I L A T E Rule

Note: When 1 is taken as second function. (जब 1 को द्वितीय फलन लिया जाता है)

(1) $\int \log x \times 1 dx$

L A

$\nearrow x^0$

I L A T E Rule

(2) $\int \tan^{-1} x \times 1 dx$

I A

$\nearrow x^0$

(3) $\int \sin^{-1} x dx$

Logarithmic function (लघुगणकीय फलन)

Inverse trigonometric function (प्रतिलोम त्रिकोणमितीय फलन)

(4) $\int \cos^{-1} x dx$



Summary:

$$(1) \int u v dx = u \int v dx - \int \left\{ \frac{du}{dx} \cdot \int v dx \right\} dx$$

(2)

ILATE Rule

$$\int e^x \sin x dx = \int \sin x e^x dx$$

| |
E T

(3) Note: When 1 is taken as second function. (जब 1 को द्वितीय फलन लिया जाता है)

$$\int \log x dx$$

$$\int \tan^{-1} x dx$$



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