Integration Formulas

- $\int u^n \, du = \frac{u^{n+1}}{n+1}$
- $\int \frac{1}{u} \, du = \ln|u|$
- $\int e^u \, du = e^u$
- $\int b^u \, du = \frac{b^u}{\ln b}$
- $\int \sin u \, du = -\cos u + c$
- $\int \cot x \, dx = \ln|\sin x| + c$
- $\int \cos u \, du = \sin u + c$
- $\int \tan u \, du = -\ln|\cos u| + c$
- $\int \operatorname{cosec} x \, dx =$
- $\int \sec u \, du = \ln|\sec x + \tan x| + c$
- $\int \sec^2 u \, du = \tan u + c$
- $\int \operatorname{cosec}^2 u \, du = -\cot u + c$
- $\int \operatorname{cosec} u \cot u \, du = -\operatorname{cosc} u + c$
- $\int \cot u \, du = \ln|\sin u| + c$

Hyperbolic Functions:-

- $\int \sinh u \, du = \cosh u + c$
- $\int \operatorname{sech}^2 u \, du = \tanh u + c$
- $\int \cosh u \, du = \sinh u + c$
- $\int \operatorname{cosech}^2 u \, du = -\coth u + c$
- $\int \operatorname{sech} u \tanh u \, du = -\operatorname{sech} u + c$
- $\int \operatorname{cosech} u \coth u \, du = -\operatorname{cosech} u + c$

Algebric Functions

- $\int \frac{du}{\sqrt{a^2-u^2}} = \sin^{-1} \frac{u}{a} + c$
- $\int \frac{du}{a^2+u^2} = \frac{1}{a} \tan^{-1} \frac{u}{a} + c$
- $\int \frac{du}{u\sqrt{u^2-a^2}} = \frac{1}{a} \sec^{-1} \frac{|u|}{a} + c$
- $\int \frac{du}{\sqrt{a^2+u^2}} = \ln\left(u + \sqrt{a^2+u^2}\right) + c$

- $$\int \frac{du}{\sqrt{u^2-a^2}} = \ln\left|u+\sqrt{u^2-a^2}\right| + c$$

- $$\int \frac{du}{a^2-u^2} = \frac{1}{2a}\ln\left|\frac{a+u}{a-u}\right| + c$$

- $$\int \frac{du}{u\sqrt{a^2-u^2}} = \frac{-1}{a}\ln\left|\frac{a+\sqrt{a^2-u^2}}{u}\right| + c$$

- $$\int \frac{du}{u\sqrt{a^2+u^2}} = -\frac{1}{a}\ln\left|\frac{a+\sqrt{a^2+u^2}}{u}\right| + c$$

Trigrometric Substitution:-

- $\sqrt{a^2-x^2} \Rightarrow x = a\sin x \quad ; \quad x = a\cos x.$

- $\sqrt{x^2-a^2} \Rightarrow x = a\sec x$

- $\sqrt{a^2+x^2} \Rightarrow x = a\tan x$

$\Rightarrow \sin 2\theta = 2\sin\theta\cos\theta$

$\Rightarrow \cos 2\theta = 2\cos^2\theta - 1$ OR $\cos 2\theta = 1 - 2\sin^2\theta.$

Magic substituition:-

- $\tan\frac{x}{2} = u$ • $dx = \frac{2}{1+u^2}du$

- $\sin x = \frac{2u}{1+u^2}$ • $\cos x = \frac{1-u^2}{1+u^2}$

Rieman's Sum:-

Left case:- $x_k = a + (k-1)\Delta x$

Right case:- $x_k = a + \Delta x\, k$ $\quad \Delta x = \frac{b-a}{n}$

Centre case:- $x_k = a + \left(k-\frac{1}{2}\right)\Delta x$

Reduction Formulas:-

- $\int \cos^n x \, dx = \int \cos^{n-1} x \cos x \, dx$
  $\hookrightarrow \; = \frac{\sin x \cos^{n-1} x}{n} + (n-1) \int \frac{\cos^{n-2} x}{n} dx$

- $\int \sin^n x \, dx = \int \sin^{n-1} x \sin x \, dx$
  $\hookrightarrow \; = \frac{-\sin^{n-1} x \cos x}{n} + \frac{(n-1)}{n} \int \sin^{n-2} dx$

- $\int \tan^n x \, dx = \int \tan^{n-2} dx \tan^2 x \, dx$
  $\hookrightarrow \; = \frac{\tan^{n-1} x}{(n-1)} - \int \tan^{n-2} dx$

- $\int \sec^n x \, dx = \int \sec^{n-2} dx \sec x \, dx$
  $\hookrightarrow \; = \frac{\sec^{n-2} x \tan x}{n-1} + \frac{(n-2)}{(n-1)} \int \sec^{n-2} dx$

By-Parts:- LIATE OR ILPET

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

Hyperbolic Functions:-

- $\cosh x = \frac{e^x + e^{-x}}{2}$
- $\sinh x = \frac{e^x - e^{-x}}{2}$
- ~~sinx~~ $\tanh x = \frac{e^x - e^{-x}}{e^x + e^{-x}}$
- $\cosh^2 \theta - \sinh^2 \theta = 1$

Area Under the Curve Σk:-

- $\sum_{k=1}^{k=n} k = \frac{n(n+1)}{2}$
- $\sum_{k=1}^{n} k^3 = \left[\frac{n(n+1)}{2} \right]^2$
- $\sum_{k=1}^{k=n} k^2 = \frac{n(n+1)(2n+1)}{6}$