Laplace Transform.

★ $L[f(t)] = \int_0^\infty e^{-st} f(t)\, dt$

Results

$L[1] = \frac{1}{s}$

$L[t^n] = \frac{n!}{s^{n+1}}$

$L[e^{at}] = \frac{1}{s-a}$

$L[e^{-at}] = \frac{1}{s+a}$

$L[\sin at] = \frac{a}{s^2+a^2}$

$L[\cos at] = \frac{s}{s^2+a^2}$

$L[\sinh at] = \frac{a}{s^2-a^2}$

$L[\cosh at] = \frac{s}{s^2-a^2}$.

Identities:

$\sin^2\theta = \frac{1-\cos 2\theta}{2}$, $\cos^2\theta = \frac{1+\cos 2\theta}{2}$.

$\sin^3\theta = \frac{3\sin\theta - \sin 3\theta}{4}$, $\cos^3\theta = \frac{\cos 3\theta + 3\cos\theta}{4}$

$\sin A \cos B = \frac{1}{2}[\sin(A+B) + \sin(A-B)]$.

$\cos A \cos B = \frac{1}{2}[\cos(A+B) + \cos(A-B)]$.

$\sin A \sin B = -\frac{1}{2}[\cos(A+B) - \cos(A-B)]$.

$\int e^{ax} \sin bx\, dx = \frac{e^{ax}}{a^2+b^2}[a\sin bx - b\cos bx]$.

$\int e^{ax} \cos bx\, dx = \frac{e^{ax}}{a^2+b^2}[a\cos bx + b\sin bx]$

★ First shifting Theorem: $L[e^{at} f(t)] = [F(s)]_{s \to s-a}$

{evaluate $L[f(t)] = F(s) \Rightarrow$ change s to $s \pm a$}.

★ $L[t f(t)] = -\frac{d}{ds}(F(s))$ or $L[t^n f(t)] = (-1)^n \frac{d^n}{ds^n}(F(s))$

★ $L\left[\frac{f(t)}{t}\right] = \int_s^\infty F(s)\, ds$. if $\lim_{t\to 0} \frac{f(t)}{t}$ exists

★ IVT: $\lim_{t\to 0} f(t) = \lim_{s\to\infty} sF(s)$;; FVT: $\lim_{t\to\infty} f(t) = \lim_{s\to 0} sF(s)$